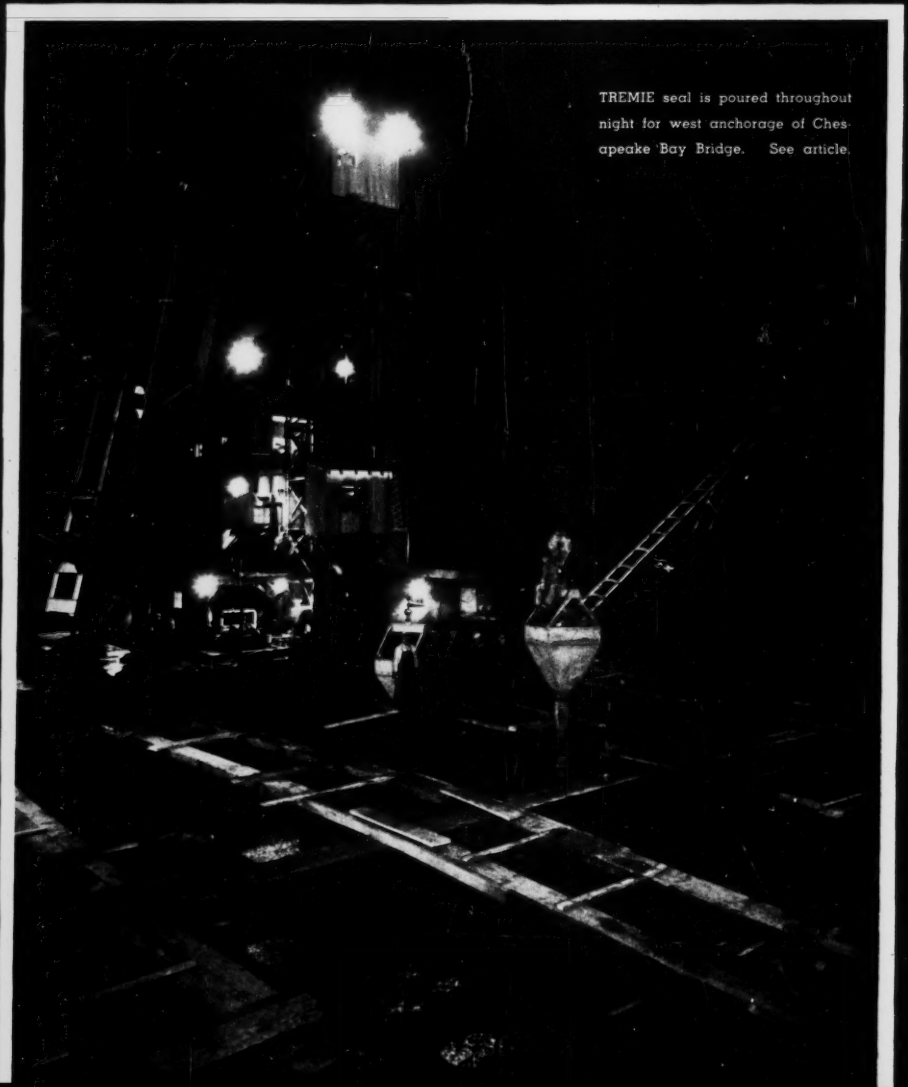
CIVIL ENGINEERING



TREMIE seal is poured throughout night for west anchorage of Chesapeake Bay Bridge. See article.

RAYMOND

versus OLD MAN RIVER

Major link in the flood-control system on lower Mississippi River is the 4,200-foot Morganza Floodway Control Structure, 42 miles northwest of Baton Rouge, La. Its 125 bays will have diversion capacity of 600,000 sec.-ft. into spillway at flood stages.

DRIVING 3,700 RAYMOND PRECAST PILES FOR MORGANZA FLOODWAY CONTROL . . .

For the foundations Raymond is casting and driving 3,734 precast reinforced concrete piles, in lengths of 80 to 120 feet. 95 percent are being driven on 2-on-1 batter.

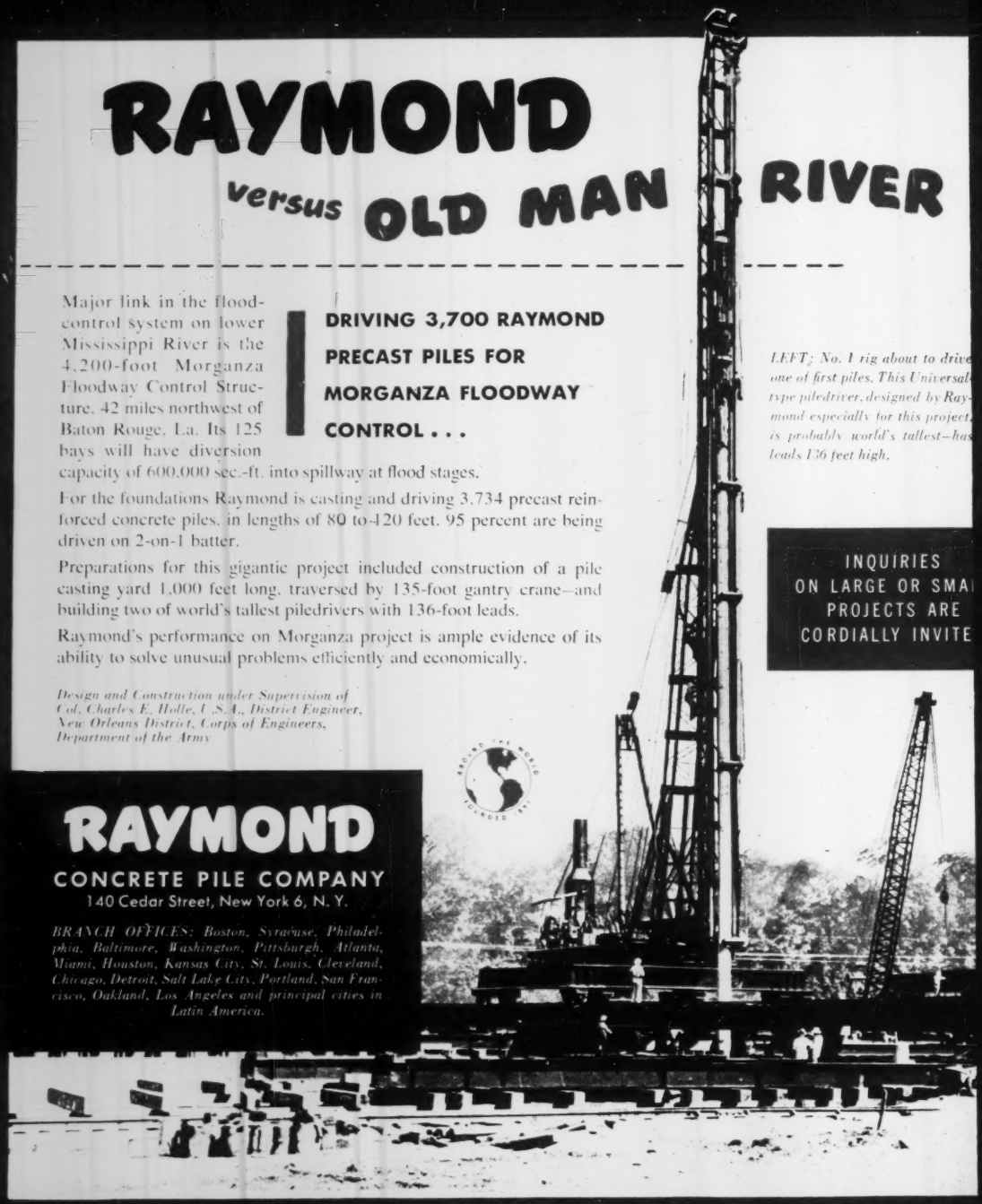
Preparations for this gigantic project included construction of a pile casting yard 1,000 feet long, traversed by 135-foot gantry crane—and building two of world's tallest piledrivers with 136-foot leads.

Raymond's performance on Morganza project is ample evidence of its ability to solve unusual problems efficiently and economically.

Design and Construction under Supervision of Col. Charles E. Holle, U.S.A., District Engineer, New Orleans District, Corps of Engineers, Department of the Army

LEFT: No. 1 rig about to drive one of first piles. This Universal-type piledriver, designed by Raymond especially for this project, is probably world's tallest—has leads 136 feet high.

INQUIRIES ON LARGE OR SMA PROJECTS ARE CORDIALLY INVITE



RAYMOND

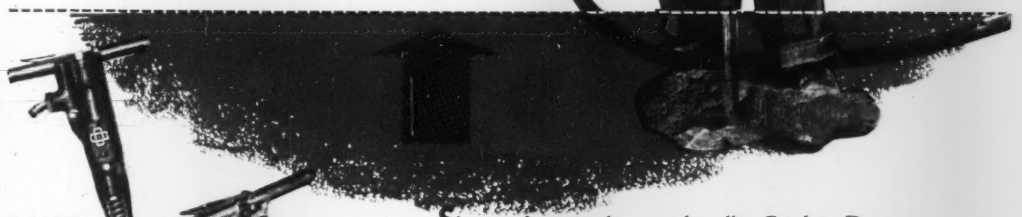
CONCRETE PILE COMPANY

140 Cedar Street, New York 6, N. Y.

BRANCH OFFICES: Boston, Syracuse, Philadelphia, Baltimore, Washington, Pittsburgh, Atlanta, Miami, Houston, Kansas City, St. Louis, Cleveland, Chicago, Detroit, Salt Lake City, Portland, San Francisco, Oakland, Los Angeles and principal cities in Latin America.

THE SCOPE OF RAYMOND'S ACTIVITIES . . . includes, in addition to borings for soil investigation, every recognized type of foundation construction—concrete, composite, precast, steel, pipe and wood piles. Also caissons, underpinning, construction involving shore protection, shipbuilding facilities, harbor and river improvements, and cement-mortar lining of water, oil and gas pipelines 4" to 144" in diameter by Centriline Corp., a Raymond subsidiary.

SHORT
WHERE IT COUNTS
...LONG
ON QUALITY



Model B67 — 63 lbs.

Model B37 — 38 lbs.

Model B87 — 81 lbs. — Sheeting driver head also available.

New Sump Pump Dependability

The VP4 Sump Pump is designed on a new principle of *Top-Suction* — won't bury itself in a muddy sump. Top-Suction also pulls gritty water away from the shaft seal — protects the seal, shaft and motor from wear — sharply reduces maintenance. "One-shot" lubrication oils entire pump for 24 hours of service.

Shorter from tool-top to handle, Gardner-Denver Paving Breakers are easier to hold! Your men move about the job faster and safer, too — thanks to the exclusive Gardner-Denver safety latch that works like the safety on a gun.

And here are some of the quality *extras* that make these breakers powerful "busters" on your demolition jobs:

Automatic short throw valve — virtually unaffected by wear.

Non-freezing exhaust — maintains top efficiency on cold, damp days.

Renewable chuck liner — protects both tool and breaker against loose-fitting shank.

Integral oil reservoir — insures proper lubrication to all working parts.

SINCE 1859

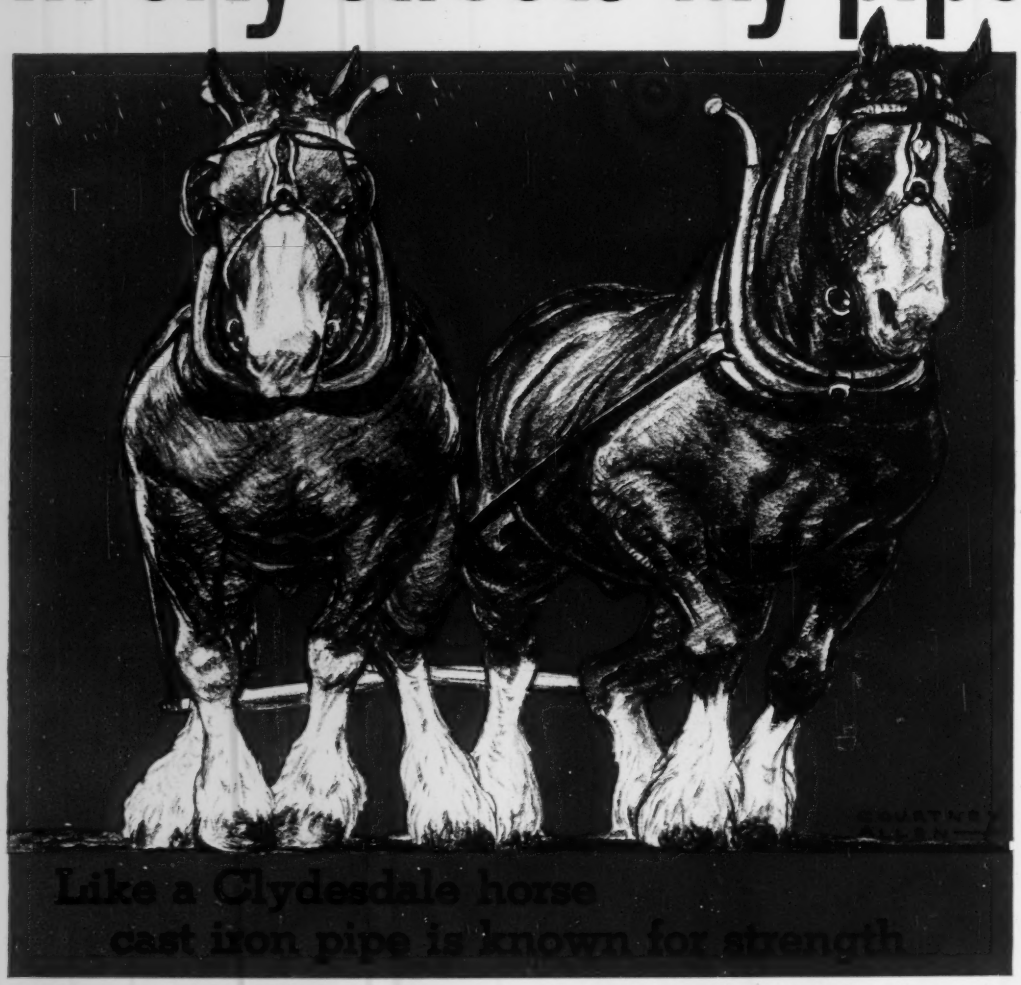
GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., Toronto, Ontario

THE QUALITY LEADER IN COMPRESSORS, PUMPS AND ROCK DRILLS

CIVIL ENGINEERING, The Magazine of Engineered Construction, May, 1951. Vol. 21, No. 5. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

in city streets lay pipe



Known strength factors! Proved resistance to corrosion! These are your only safe and sure guides to long life and low maintenance expense of water, gas and sewer mains laid under costly modern pavements. The four strength factors that pipe must have to survive traffic shocks, heavy external loads, beam stresses and severe working pressures are listed on the page opposite. *No pipe that is deficient in any of these strength factors should ever be laid in paved streets of cities, towns and villages.* Cast iron water and gas mains, laid over a century ago, are serving in the streets of 30 or more cities in North America. These attested service records prove that cast iron pipe not only assures you of effective resistance to corrosion but all the strength factors of long life and economy, as well.

known for STRENGTH

No pipe that is deficient in any of the following strength factors should ever be laid under paved streets.

CRUSHING STRENGTH

The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH

When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

SHOCK STRENGTH

The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

BURSTING STRENGTH

In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

CAST IRON

CAST IRON PIPE RESEARCH ASSOCIATION, THOS. F. WOLFE, MANAGING DIRECTOR, 122 SO. MICHIGAN AVE., CHICAGO 3.

CAST IRON PIPE SERVES FOR CENTURIES

"Big Red"

turns prairies into projects.

BAREFOOT EASE on a hot summer day in Memphis, Tennessee! This TD-24 and another big red International belonging to the G. & Z. Construction Company do all the grading and improvement work on a new Memphis housing project.

TD 24

Contractors tighten up the time cycles with International's "Big Red" champ

When the champ "goes domestic" and the world's most powerful crawler turns to housing projects, towns take shape while you watch.

When the TD-24 lets loose its power and speed to grade a road, fill a swamp, or doze off home sites on hillsides—the work gets done almost before you can say "Where's the concrete?"

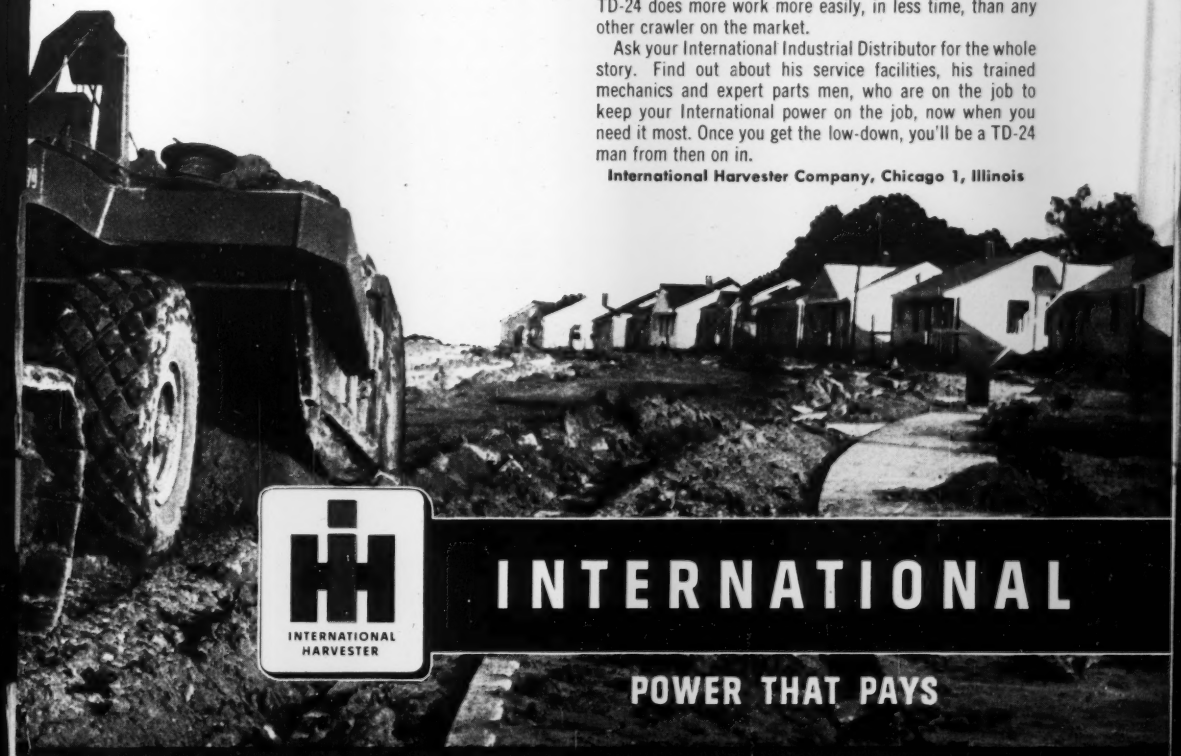
Here's what's behind it—here are the facts that make the big red International TD-24 the champ of the time cycle:

- **148 maximum drawbar horsepower—more than any other crawler.**
- **Eight forward speeds, eight reverse.**
- **Speeds up to 7.8 mph in either direction.**
- **Synchromesh transmission—you shift "on-the-go."**
- **Exclusive International push-button, all-weather starting.**
- **Planet Power steering—with finger-tip control for pivot turns, feathered turns, turns with power on both tracks plus instant shift up or down one gear without declutching.**
- **Reserve torque overcomes overloads, increases drawbar pull for bigger scraper and bulldozer loads.**

Contractors, operators, men who know performance are passing the word around. They're telling each other how the TD-24 does more work more easily, in less time, than any other crawler on the market.

Ask your International Industrial Distributor for the whole story. Find out about his service facilities, his trained mechanics and expert parts men, who are on the job to keep your International power on the job, now when you need it most. Once you get the low-down, you'll be a TD-24 man from then on in.

International Harvester Company, Chicago 1, Illinois



INTERNATIONAL HARVESTER

INTERNATIONAL

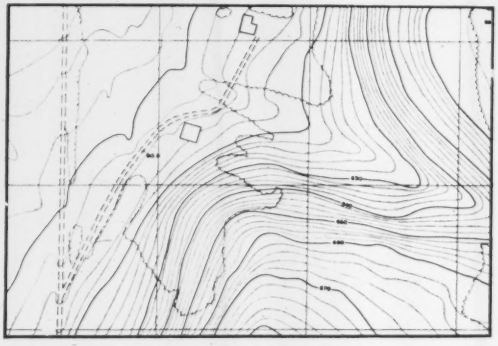
POWER THAT PAYS

AERO RUSHES MAPS FOR AMERICA'S LARGEST DEFENSE PLANT

MAPPING PLANE *flew 200,000 acres in less than 2 weeks. Pilot-photographer team plans work before take-off.*

FIELD-SURVEY PARTIES *establish ground control for air survey. Radio transceivers facilitate communication between crews.*

PRECISE STEREOPLOTTING INSTRUMENTS *are used in compiling contour maps, on a round-the-clock schedule.*



RICH IN DETAIL *and reliable in topographic data, the aerial contour maps will be used for design and construction.*

MAPPING for America's largest defense plant—the AEC facility to be built in South Carolina—is already months ahead of the time required for ground surveys!

First photo-mapping flights over the 200,000-acre tract were made early in January. Fifteen days later, AERO delivered maps for the top priority 1,000-acre area. Working round-the-clock map compilation schedules, it will deliver maps for the entire area within five months.

AERO is doing this huge rush job because it has the equipment and trained personnel to deliver the maps with speed, accuracy and economy. AERO's record of furnishing detailed, dependable maps for such projects as the big Oak Ridge area and numerous war production facilities during World War II, make it a natural selection for this and other essential mapping today.

AERO also speeds mapping at low cost and high accuracy for new plants and industrial developments, city planning, highways and railroads, oil and mining exploration, or any project covering large areas. For more information write AERO today.

AERO

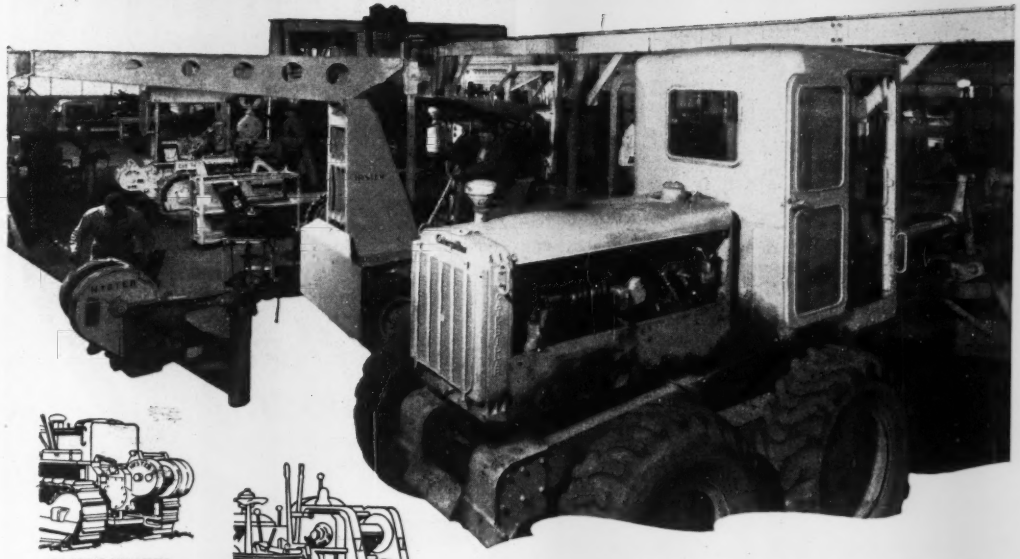
SERVICE CORPORATION

236 E. COURTLAND ST., PHILA. 20, PA.

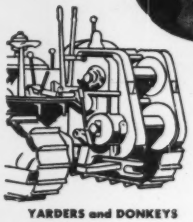
Oldest Flying Corporation in the World

TOPOGRAPHIC MAPS • PLANIMETRIC MAPS • PRECISE AERIAL MOSAICS • AIRBORNE MAGNETOMETER SURVEYS • RELIEF MODELS • COLOR PHOTOGRAPHY

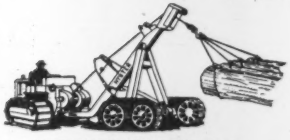
How to Make Your CATERPILLAR-HYSTER® Equipment Last More Years



TOWING WINCHES

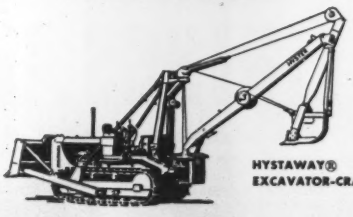


YARDERS and DONKEYS



LOGGING ARCHES and SULKIES®

GRID ROLLERS



HYSTAWAY® EXCAVATOR-CRANES

Put yourself in the hands of your Caterpillar Tractor Company dealer. He can keep your tractor and tractor tools running better at lower cost. He has factory trained mechanics who *know* Caterpillar and Hyster equipment. He backs up skilled mechanical knowledge with an efficient parts department.

Service is his business. And the times being what they are, we suggest that you rely upon your dealer to keep your Caterpillar tractor and Hyster tractor tools working at full capacity longer.

HYSTER COMPANY

2999 N. E. CLACKAMAS STREET, PORTLAND 8, OREGON
1899 NORTH ADAMS STREET, PEORIA 1, ILLINOIS

Old pipe reconditioned by cement mortar lining.

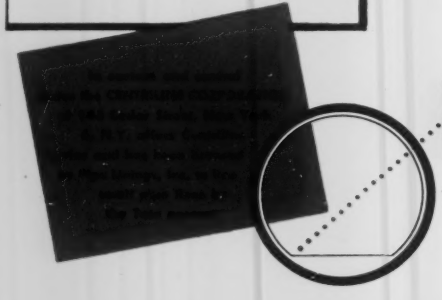
MAKE YOUR OLD PIPE LINE PERFORM LIKE NEW...

at much less than new pipe line costs!

FOR WATER, GAS AND OIL PIPE LINES OF 4" DIA. AND UP

Before reconditioning. After reconditioning.

- Restore flow coefficients.
- Reduce pumping costs.
- Prevent leakage.
- Protect against corrosion.
- Protect against discoloration and contamination.



Patented Cement Mortar Lining Processes Recondition Lines in Place

Are you encountering leaks, reduced flow capacity or other pipe line troubles due to failure in service of an old pipe line?

If so, reconditioning by the famous TATE and CENTRILINE processes can solve your problems quickly, efficiently and economically.

These processes use patented equipment that thoroughly removes all tuberculation and incrustation and applies a smooth, continuous cement mortar lining of proper thickness. All the work is done with the pipe line in place and with only momentary interruption of service to install by-pass lines.

The thoroughly reconditioned pipe gives practically new and permanent pipe line performance at much less than new pipe line costs. Write for complete details today.

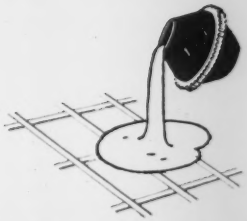
PIPE LININGS, Inc.

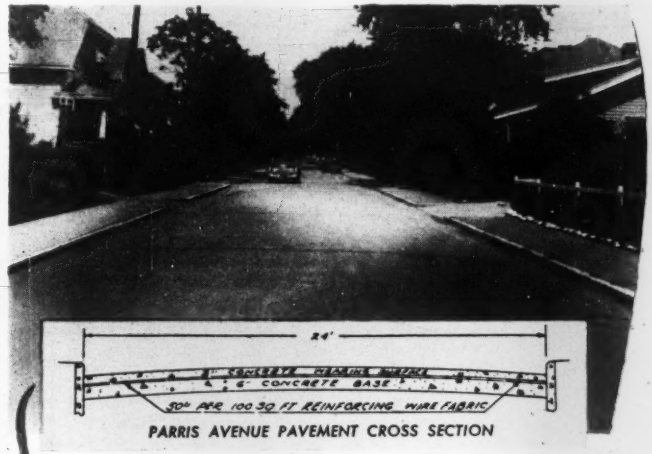
A subsidiary of

AMERICAN PIPE AND CONSTRUCTION CO.

P. O. Box 3428, Terminal Annex, Los Angeles 54, California

Make First Pavements *Last* with American Welded Wire Fabric





PARRIS AVENUE PAVEMENT CROSS SECTION

THESE PAVEMENTS were laid on 43rd Street in the month of June, 1924, and on Parris Avenue, both in Indianapolis, Indiana, in the month of October, 1923. The unretouched photos show that both are still in first class condition in the year 1950. The diagrams show details of construction, which, except for variations in width and thickness, are the same as those used in the latest interurban highways and city streets.

43rd STREET PAVEMENT CROSS SECTION

THE two streets illustrated here were paved with concrete, reinforced with American Welded Wire Fabric, in 1923 and 1924 respectively. They are still, as you can see, in first class condition.

This sort of service record has won general preference for American Welded Wire Fabric among highway commissions, engineers and contractors. They have specified this outstanding reinforcement for hundreds of thousands of miles of fine modern multi-lane highways, busy traffic arteries and city streets all over the country.

U·S·S American Welded Wire Fabric has definite structural superiority to other forms of concrete reinforcement. It distributes the strength of steel evenly throughout the concrete, fortifies the slabs against all-directional stresses, provides positive control of any cracking that may occur and, because of its welded intersections of small high strength steel members closely spaced, forms a secure bond with the concrete.

When next you consider paving, be sure you are fully informed upon the superior riding qualities, safety and durability of concrete, reinforced with American Welded Wire Fabric. And remember, on a cost per year basis it is the most *economical* pavement for streets and highways.

Many standard designs and sizes of American Welded Wire Fabric are now readily available from jobbers' and dealers' stocks, supplemented by prompt mill shipments to identified projects. Our technical staff will be glad to consult with you regarding your individual requirements. Literature which contains valuable information is yours for the asking. Just drop a line to our nearest sales office.

AMERICAN STEEL & WIRE COMPANY
GENERAL OFFICES: CLEVELAND, OHIO

COLUMBIA STEEL COMPANY, SAN FRANCISCO
PACIFIC COAST DISTRIBUTORS

TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM
SOUTHERN DISTRIBUTORS

UNITED STATES STEEL EXPORT COMPANY, NEW YORK

Every concrete paving job needs

USS

AMERICAN WELDED WIRE FABRIC

reinforcement

UNITED STATES STEEL

The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

Is Polaris on Your Parties?

"Next time you're afraid that errors may be piling up along your line, call on the north star to set you straight," suggests William E. Weigle, City Engineer of York, Pennsylvania. "Every surveyor knows the value of Polaris, but too few of us actually use it."

"A few years ago, we were hounded by taxpayers, trying to find their property's relation to the city boundary. The line was last run in 1888, and large areas had been annexed to York since that time. Confusion was mounting, so a precise survey seemed the only answer.

"We found only four stones surviving from the old survey, and had to start practically from scratch. The line proved to be 11.4 miles long with 77 *changes of direction*. Obstacles—natural and man-made—faced us all along the way, so we feared that error might be creeping into the work. But, by taking observations on Polaris, we saved ourselves considerable grief.

"Wanting to use the star at elongation—to take advantage of the 20 minutes when total changes in azimuth is only six seconds—we checked our Gurley *Ephemeris;* and made the

first observation after midnight, in below-freezing weather. This result was carried to another point about two and one-half miles distant in longitude, where a second observation was made. Allowing for convergence of meridians, we found the bearings did not agree. Checking computations pinned down the error...saved carrying it around the city.

"In all, we made five observations—the last, fortunately, on a much warmer evening in spring. Through these observations—and good instrument work—the survey was closed without any angular error."

Bill Weigle carries a plastic refrigerator bag in his instrument case; slips it over his transit during flash rains in the field...Send us your problem-solution and/or a tip for this space.

Two Jobs—A Gurley on Each

Bill Weigle works five and a half days a week at his job in York City Hall. In spare time, he continues a private civil engineering practice in which two sons, Robert and Donald, will join him after graduation from the Rensselaer Polytechnic Institute.

On both the city job and in private work, Weigle uses Model 132-R Gurley Transits—one, a "minute gun"; the other, "20 seconds." Weigle says, "The two *dependables* – the north star and a Gurley Transit—make a team any engineer can count on for his most accurate work."

Take a tip from Bill Weigle. Investigate versatile Gurley Transits. For complete details, write for Bulletin 50.

W. & L. E. GURLEY, 518 FULTON STREET, TROY, N. Y.

Surveying and Engineering Instruments, Hydraulic Engineering Instruments, Standard Precision Weights and Measures, Paper and Textile Testing Instruments, Reticle Making Facilities, Aeronautical Navigating Instruments, Meteorological Instruments.

GURLEY

Surveying and Scientific Instrument Makers Since 1845

Sgt. Robert Chrisman levels a field at the eastern end of the Davison airstrip, Ft. Belvoir, Va., with a "Cat" D7 Tractor. In the background are four "Cat" No. 12 Motor Graders completing runway.

THE MILITARY GETS FIRST CALL

THESE "Caterpillar" earthmoving machines, working on the runway of the Davison airstrip at Ft. Belvoir, Va., show at a glance where a lot of "Cat" equipment is going these days. And that's how it's got to be.

Defense Rated Orders get first call as America's military establishment prepares for what may come. The urgent build-up of our power has meant drafting machines as well as men. An ever-increasing flow of "Caterpillar" equipment and parts is going to the support of America's fighting men and to defense projects.

This means that there already exists a scarcity of "Cat" equipment and engines for civilian use. So it is to *your* advantage to make the machines you now have *last*. You can keep them on the job longer by doing these things:

1 Follow sound and recommended operation and maintenance procedures to the letter. Read and reread your Operator's Instruction Book.

2 Make full use of your "Caterpillar" dealer's facilities for servicing and rebuilding machine parts.

3 Anticipate future parts needs, then contact your dealer and let him help. But *don't* buy or order parts you don't actually need.

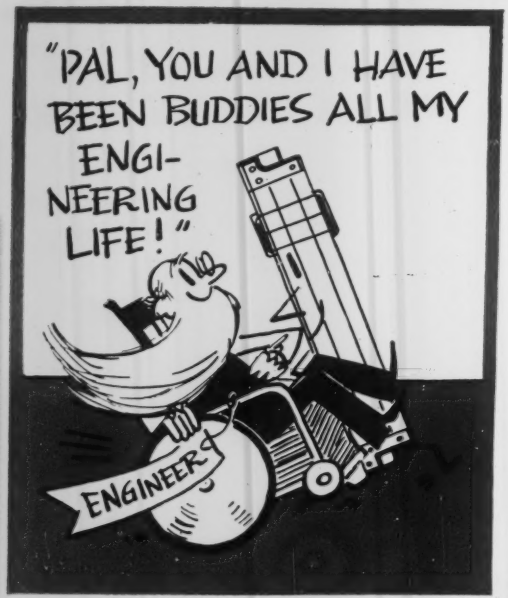
Caterpillar Tractor Co. will do everything possible to maintain every "Caterpillar" machine in the field, to provide new machines as fast as possible, and to allocate them as fairly as possible.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

CATERPILLAR

REG. U. S. PAT. OFF.

DIESEL ENGINES • TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT



Ask anybody what he knows about Keuffel & Esser, and he first starts rhapsodizing about slide rules. Slide rules and K&E are synonymous.

And they're both almost as long lasting as the pyramids!

Keuffel & Esser have been around since 1867 and they completed their first batch of slide rules in 1891.

It is not uncommon to hear of a K&E rule which has been in service for over 50 years.

I used to think a slide rule was a slide rule—just as a yard stick is a yard stick—but there is a sensational variety of 'em in the K&E line—from the simple Mannheim to the more complicated brethren, such as the Log Log Duplex Trig and Decitrig and the Log Log Duplex Vector*.

Also, there are several sizes from the handy pocket rules, to the more common 10-inch, up to the 20-inch longfellows.

There's no point to hitching up for life with a "second best" slide rule when you can play a Keuffel & Esser.

*Trade Marks

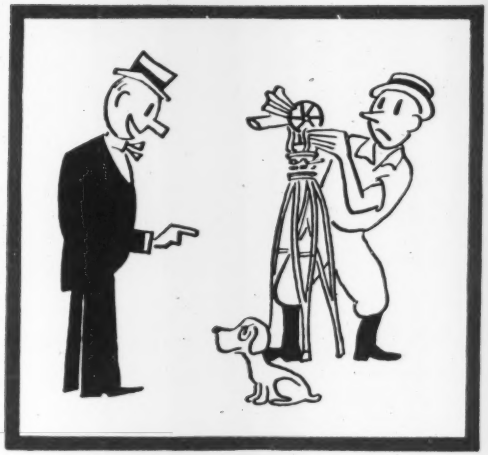
Down through the years with a K&E Slide Rule

Although K&E Slide Rules are the oldest slide rules made in America, there are no whiskers on 'em—except cat's whiskers (I mean, symbolizing precision).

If you are an old engineer, you probably regard your K&E Slide Rule as a priceless Stradivarius. You are probably figuring on passing it down to your grandchildren.

If you are a beginner, the sooner you attach yourself to an immortal K&E rule, the better.

K&E Slide Rules have become accepted symbols of the engineering profession. If a photographer, illustrator or cartoonist wants to indicate that his hero is a top-flight engineer, he puts a K&E Slide Rule in his hand or in the immediate environment.



"PARAGON, eh . . . . . has it a pedigree?"

Yes, sir, there's a long pedigree to every K&E PARAGON* Surveying Instrument.

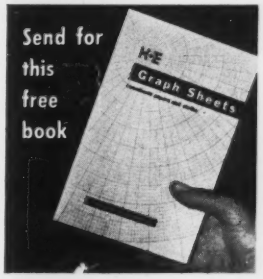
When you buy surveying instruments, you're not buying toothpicks or neckties. You're buying accuracy and endurance for a lifetime. And you're spending real money.

You want to know about the optics, the accuracy, the metals used, the wear on moving parts, the permanency of adjustment, the resistance to dust and moisture, the workmanship—and many other things.

These questions are all pretty well answered in Keuffel & Esser's 83-year-old reputation for making mighty good things for engineers and draftsmen. For 83 years, K&E equipment and materials have been partners in nearly every engineering project of any size anywhere. So, that's why I say: buy K&E PARAGON Surveying Instruments.

K&E make 300 different kinds of Graph Sheets

What do you want to graph—Grandma's health or variations in the price of spinach—polar coordinates or the surface tension of prunes?



K&E have a graph form for almost anything. Ask your K&E distributor or the factory for a catalog of their 300 forms, or if you need one they don't have, maybe they'll make up one for you, tailor-made.

They have graph sheets for plotting scientific data—square or rectangular section, logarithmic, reciprocal, electrical, and such. And forms for sketching and drawing, whether mechanical and architectural or for surveying and mapping. Also, business and financial graph forms—time series, data sheets and percentage. Their forms are on high quality tough drawing paper and on top quality tracing papers (including the famous ALBANENE*). Don't grope—graph . . . on a K&E form.

*Trade Mark ®

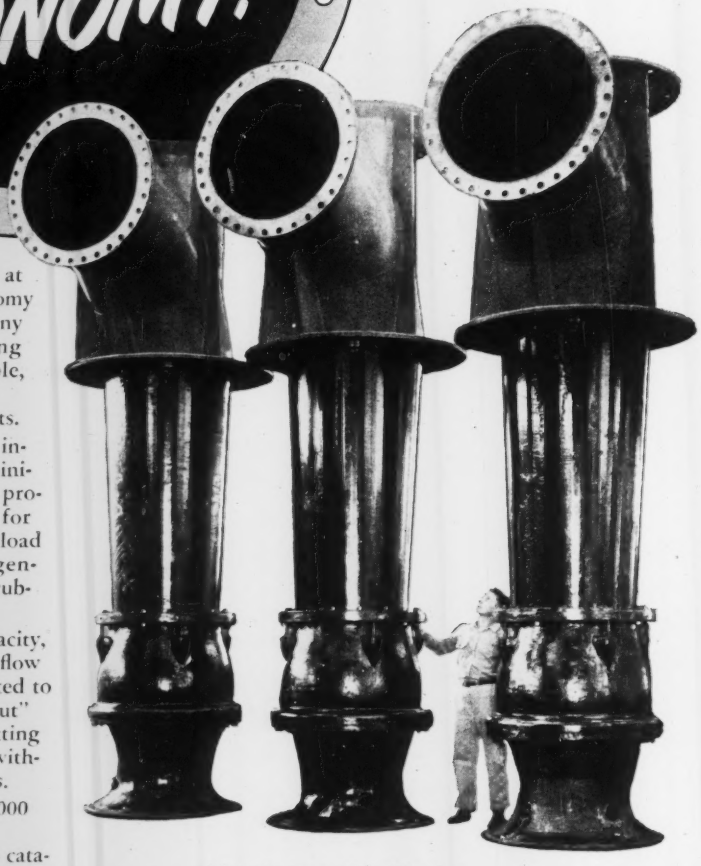
K&E
partners in creating
For 83 years K&E equipment and materials have been partners of the draftsman, engineer and scientist in shaping the modern world.

KEUFFEL & ESSER CO.

pumping LARGE volumes?

LOOK TO ECONOMY!

Economy mixed-flow pumps, each 28,000 G. P. M., 35-ft. TDH, 575 RPM, for condenser circulation in Georgia public utilities plant.



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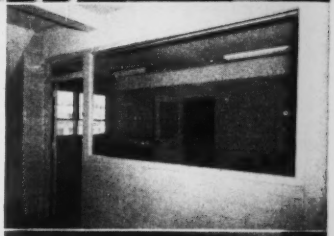
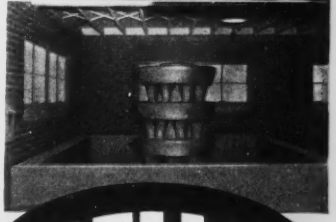
HOW INFILCO EQUIPMENT HELPED CLEAR LAKE, IOWA MEET ITS WATER PROBLEM

ENGINEERS: STANLEY ENGINEERING COMPANY, MUSCATINE, IOWA





Varying Raw Water Characteristics And Summer Population Increases were plaguing the City of Clear Lake, Iowa. Located on one of Iowa's outstanding blue-water lakes, the city's permanent population of 4,000 increased each summer to about 10,000. This taxed the water plant's capacity until it was operating on a direct pumping basis. Unpleasant, heavy tastes and odors of algae origin were noted during the summer. Then, occasional high winds would raise the normal turbidity of the lake from 25 ppm to 500 ppm or more.

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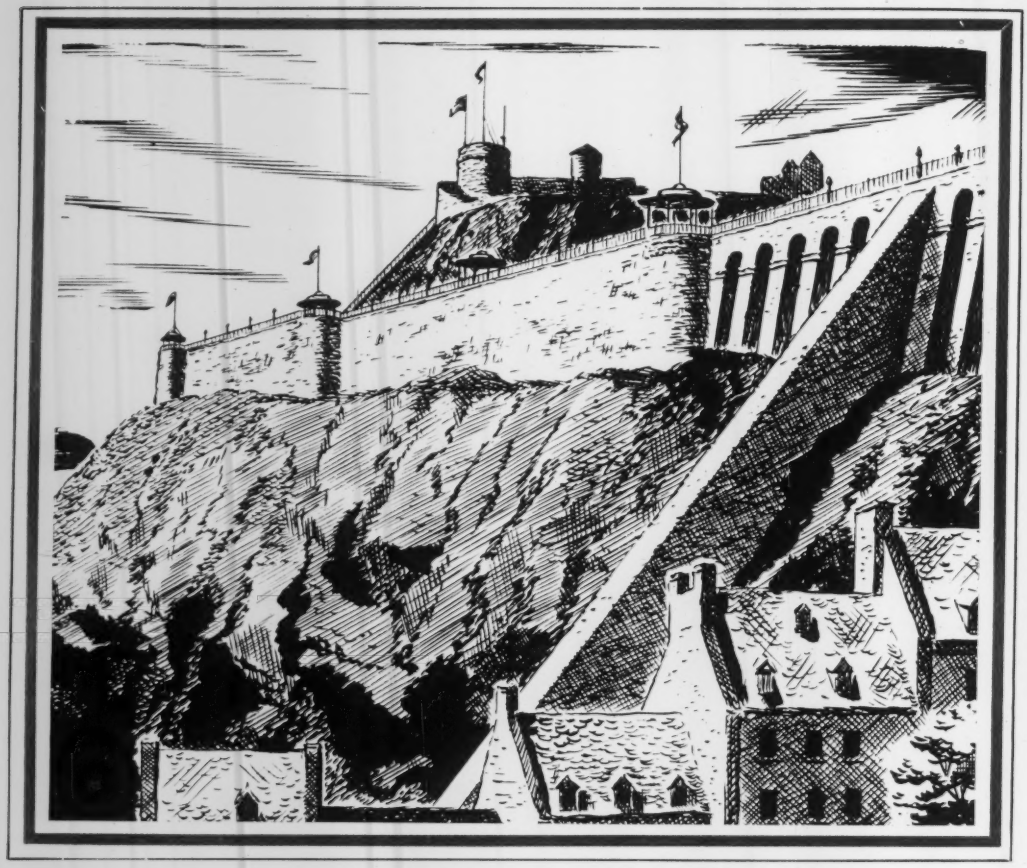

Quebec's famous Citadel, over 330 feet above the St. Lawrence, as it looked 100 years ago

Romantic Quebec has a cast iron gas main in service that was installed over a century ago. Reminiscent of those days are the horse-drawn vehicles for nostalgic tourists. Now, how could the gas engineers have foreseen the advent of trailer-trucks and giant buses, and the resultant traffic-shock? . . . That sewers and conduits for utility services would ultimately share the underground at risk of soil disturbances? Yet that gallant old cast iron main has had the necessary shock-strength and beam strength. Effective resistance to corrosion, as well as strength, are *must* factors of long life in pipe to be laid under city streets. This is shown by the fact that cast iron water and gas mains, laid over 100 years ago, are still serving in the streets of more than 30 cities in the United States and Canada.

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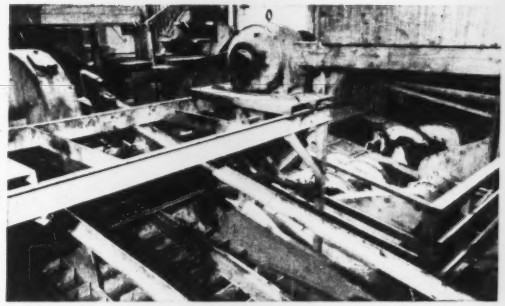
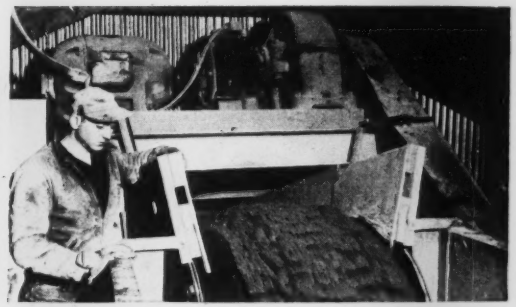
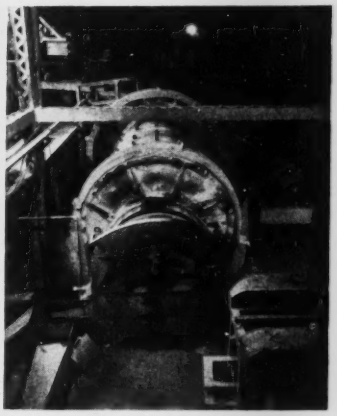


Aggregate under 6 inches is separated in shakers at screening plant. A G-E 5-hp motor drives shakers. Plant is completely automatic.



Carrying cement mix along this indoor conveyor system is a crucial step in construction of the dam. Sturdy G-E 100-hp motor drives the belt.

Aggregate for batching plant at Hungry Horse Dam is carried 1600 feet up the canyon wall by conveyor, driven by reliable G-E 100-hp motors in wooden sheds at intervals of 250 to 300 feet.



This Marcy rod mill, used in the gravel-crushing operation at the screening plant, is driven by a G-E 200-hp motor (right center). The motor is protected against heavy dust.

push-button aggregate processing at 700 tons/hr.

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General-Shea-Morrison, contractors for the Bureau of Reclamation's Hungry Horse Dam, are going all-out with electric equipment. Best example is their aggregate plant with its network of interconnecting conveyors geared to process 700 tons of raw aggregate every hour. It's one of the most modern installations of its kind in the country—strictly a push-button operation from raw aggregate handling to mixing. Only with modern electric drives can this world's fourth largest dam be completed on schedule in 1952.

As time goes on, contractors are discovering more and more that it pays to electrify. With co-ordinated use of G-E motors and control and G-E power-distribution systems, they're getting safer, more flexible, and more efficient operation. *Apparatus Department, General Electric Company, Schenectady 5, N.Y.*

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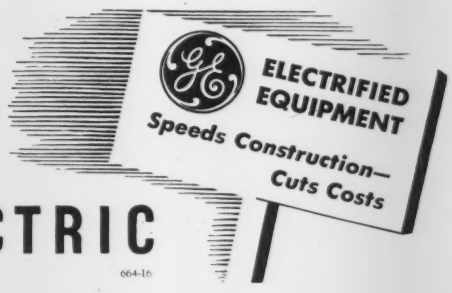

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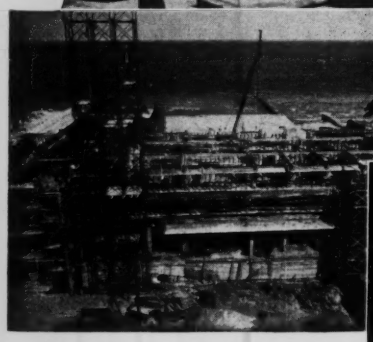

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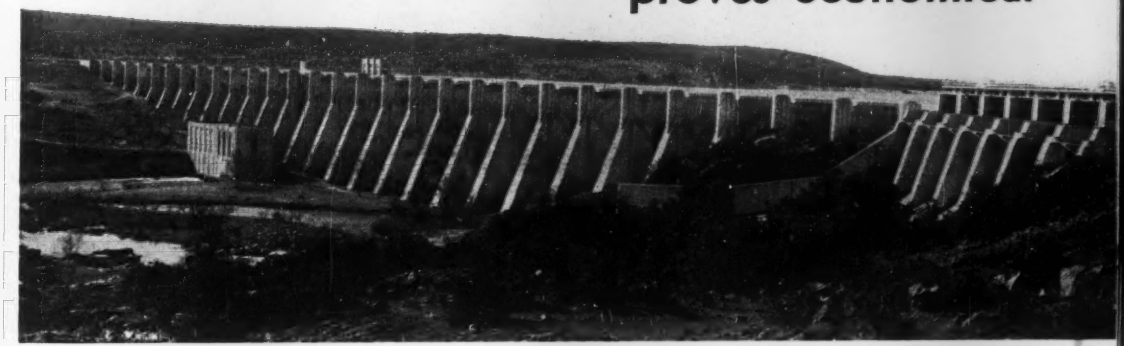
Pumped-storage hydro plant in Texas proves economical



ONE OF first applications of pumped storage to increase peak capacity of hydro project in the United States was recently completed at Buchanan Dam, Tex., by installing 804-cfs Worthington pump in extension to existing hydro plant. It pumps against head of 120 ft from reservoir (Inks Lake) whose headwater backs up to pump intake. See sketches on following page.

G. E. SCHMITT, Assistant General Manager and Chief Engineer, Lower Colorado River Authority, Austin, Tex.

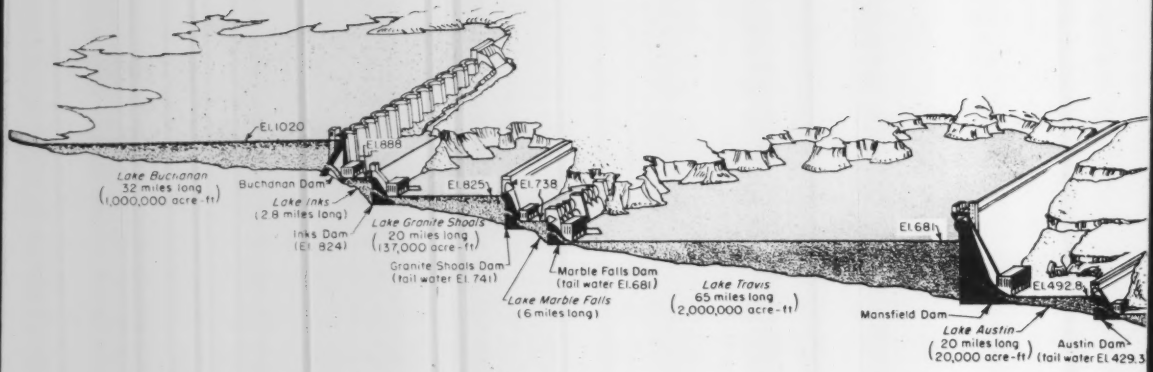
THE AUTHORITY with which the author is connected is charged with the responsibility for controlling devastating floods; storing and distributing water for irrigation and power; developing, generating, distributing and selling hydroelectric and steam power in Texas; and preventing soil erosion and developing forests on the watershed of the river. Facilities for these purposes have been constructed without tax money or direct appropriations by the state. Since 1934 more than 3,000,000 acre-ft of storage has been provided, and six hydro plants and one steam plant have been connected up by 1,050 miles of transmission lines to serve 33 cities and 11 rural electric cooperatives, which in turn serve 250 smaller communities, totaling 750,000 people in all. The Authority sells more than 50 percent of its capacity to interconnected, steam-operated electric systems for peaking and emergency service.

Since September 1950, a motor-driven pump of 804-cfs capacity, installed in the powerhouse at Buchanan Dam, has been using cheap off-peak steam power to pump water back into Lake Buchanan against heads up to 120 ft. Water is pumped at night and during week-ends, to be released through the turbines during periods of peak demand. The economics of the Buchanan Dam pumped-storage development, one of the first in the country, the selection of the machinery and some of the construction problems here discussed, were first described by Mr. Schmitt before the Power Division session presided over by Milton G. Salzman, M. ASCE, and held during the ASCE Houston Convention.

WHEN the study was made that resulted in the installation of a pumped-storage unit at Buchanan Dam, the Lower Colorado River Authority was operating hydro plants with installed capabilities totaling 150,000 kw plus a steam plant of 60,000-kw capacity. Nearly half of this 210,000 kw was being used to supply normal load requirements at 50 to 60-percent load factor. The remaining capability was used to furnish peaking and standby capacity to interconnected customers.

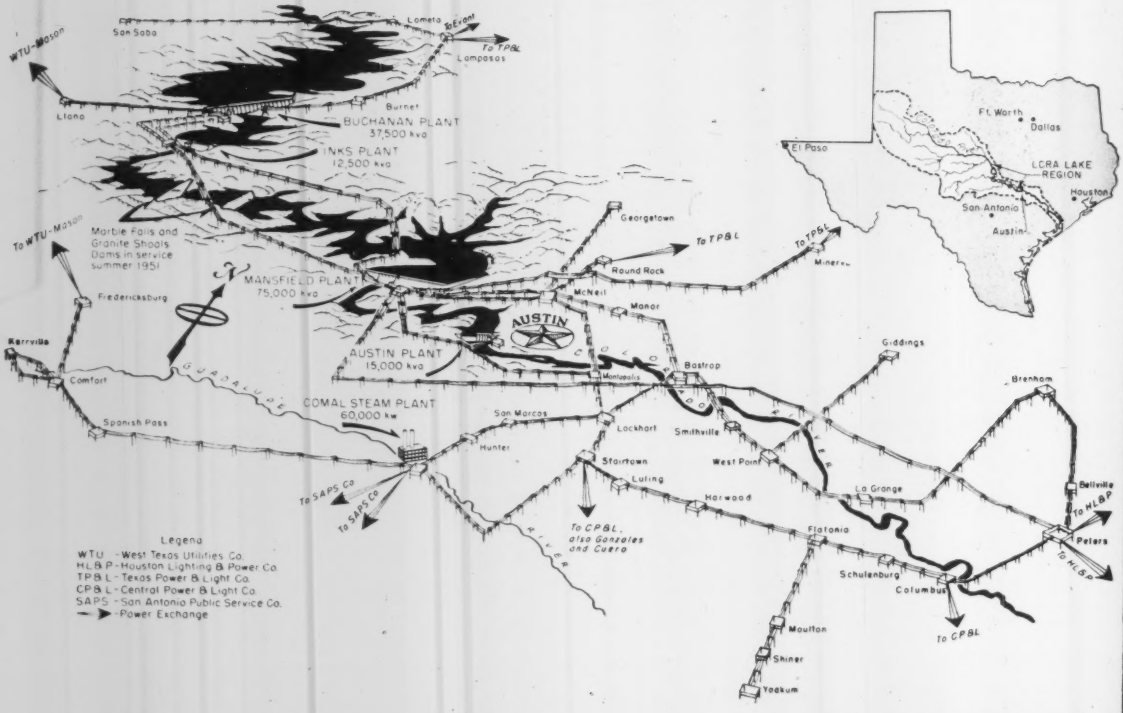
A detailed study, including typical week-day and Sunday load curves covering a ten-year forecast, was made. The load-duration curves which were prepared verified the opinion that the additional capacity then required would be operated on the basis of a low annual load factor. This conclusion made the provision of more steam-plant capacity unfavorable as compared with more hydro capacity.

Additional power was required before the summer peak in 1950, but construction of a dam, powerhouse and supplementary facilities would have made it necessary to work on a very crowded schedule. The installation of a third generating unit at Buchanan Dam was approved since provision had been made for the future installation of a third turbine



WHEN BUCHANAN DAM was built in 1936, two 12,500 kv hydro units were built into its powerhouse with provision for a third unit recently installed. Lower Colorado River Authority stores total of over 3,000,000 acre-ft of water for flood control and generates power to serve 750,000 people.

TO CONTROL turbulent Colorado River of Texas, Texas legislature created Lower Colorado River Authority as state agency in 1934. Major dams, reservoirs, power plants, transmission lines and other facilities of Authority are valued at $57,000,000. Interconnections with five adjoining systems facilitate power exchange.



and generator when this dam was built. The intake works had been constructed and a short piece of penstock 12 ft in diameter had been installed. An extension to the existing powerhouse and the installation of headgate, penstock, generator and powerhouse equipment were the major items required to obtain the additional power needed.

A review of stream-flow records revealed that sufficient water would not be available during the dry cycles for three-unit operation under normal head at Buchanan. Further study gave conclusive evidence that the installation of a pump capable of delivering into Buchanan Lake during off-peak hours a sufficient amount of water to permit three-unit operation during the dry cycle was practicable and economically feasible.

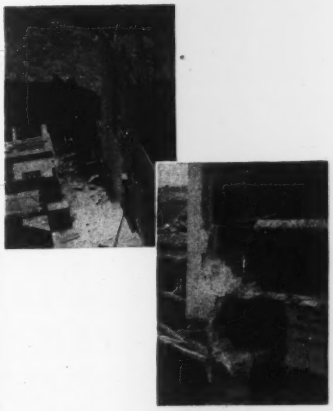
To make sure that Inks Lake Reservoir, just below Buchanan Dam, had sufficient storage in the top 4 or 5 ft to permit continuous operation of the pump over a week-end period without a prohibitive amount of tailrace excavation at Buchanan, the amount of water in Inks Lake was measured by operating the Inks Plant continuously during a period when the Buchanan Plant was shut down. From these data it was determined that 38 hours of proposed pumping would lower the level of Inks Lake by only 3 ft.

Since there was the possibility of pumping more water in order to obtain firm energy at a higher load factor for Buchanan's units Nos. 1 and 2 during dry periods, it was decided to install a motor and pump separate from the third generator and turbine to obtain the highest efficiency possible.

Pumped Storage Operation

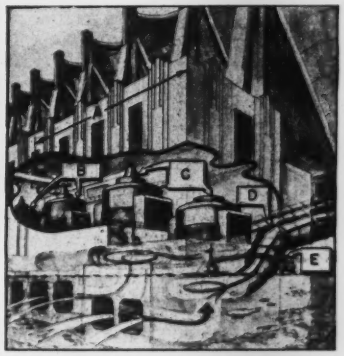
During peak hours the Buchanan Plant is operated like any other hydro plant; that is, water released from Buchanan Lake passes through the turbines to generate the required power. This water flows into Inks Lake, where a part is used to operate the Inks Plant and the remainder takes the place of that previously removed by pumping. During off-peak hours, when steam energy is available, the pump is started in the following manner.

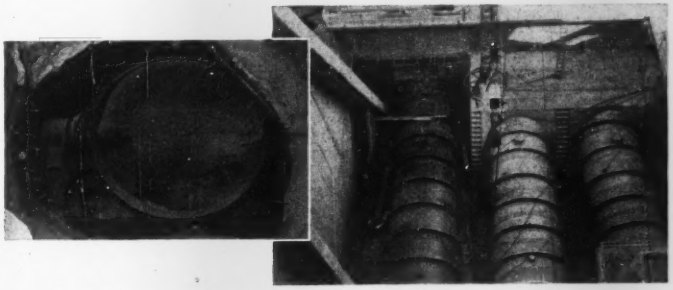
The armature circuits of the generator and motor are connected and full field applied to both units. The turbine gates are gradually opened, causing the generator to come to synchronous speed. The motor is accelerated to normal speed by the synchronous torque developed. All this is done with the butterfly valve



REINFORCED CONCRETE north wall of powerhouse was broken through by impact of heavy iron ball suspended from crane so that addition for third generator and pump unit could be joined to existing structure.

IN 64-FT extension to Buchanan Powerhouse (below) one 17,300-hp turbine and generator unit and separate 804-cfs pump and motor were placed in operation in 1950. (A) Powerhouse extension; (B) two existing generators; (C) new turbine and generator, and new motor and pump; (D) penstock, 12-ft dia, from pump; (E) motor-operated butterfly valve.

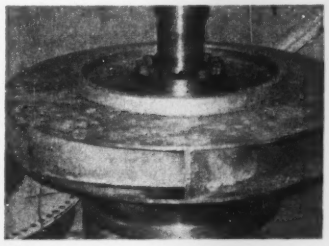


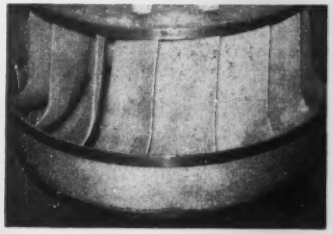


MOTOR-OPERATED butterfly valve of 12-ft diameter, made by S. Morgan Smith & Co., is installed in pump discharge line to isolate pump from penstock when unit No. 3 is operating.

NEW PENSTOCK enters powerhouse extension at left (looking down) of two original penstocks. Inside building, new penstock divides and one branch goes to turbine No. 3, the other to pump.

BRONZE pump impeller (below), made by Worthington Pump Co., is hand polished to obtain maximum efficiency. Diameter is 11 ft 8 in. Efficiency reaches 89 percent when pumping 800 cfs against 120-ft head.





VERTICAL-SHAFT turbine runner of Francis type, made by Baldwin Locomotive Works, develops 17,300 hp at 120-ft head in Buchanan Power Plant. Runner is 9 ft in diameter.

TAILRACE of Buchanan Powerhouse had to be deepened 3 ft to bring headwaters of Inks Lake up to pump intake and to increase head on Buchanan generating units.

closed. After the generator and motor are brought to synchronous speed, the two units are synchronized with the remainder of the system and load is applied to the motor by opening the butterfly valve. The generator is then shut down as the power requirements of the motor are supplied from steam generating sources.

Management's approval of the installation of a third generating unit and a separate pumped-storage unit at Buchanan Dam power station was influenced by the following considerations:

1. To supply short-duration additional peak power, the flexibility of hydro units gives them advantages over steam units.

2. Because provisions for installation of a third generating unit were made at the time Buchanan Dam and powerhouse were built, the estimated installed cost of $115 per kw for the unit did not exceed the cost of equivalent steam generating capacity.

3. An abundant supply of water from Inks Lake for pump operations was assured.

4. On-peak energy is worth from two to three times as much as the off-peak energy that would be available for pumping. An abundant supply of off-peak energy was assured from the Authority's steam plant and from other steam plants in the interconnected system at a cost that would permit economical pumping of water.

5. No appreciable increase in personnel would be required to operate the additional facilities.

6. Sufficient stream flow can be expected during three years out of every ten to permit operation of three generating units with curtailed pump operation.

7. The third generating unit will permit utilization for power generation of flood waters that would otherwise be released through the flood gates.

Major items of equipment included the following:

Generator. 12,500 kva, vertical-shaft water-wheel generator capable of producing 14,000 kw at full head without exceeding the temperature limit.

Turbine. 17,300-hp turbine at 120-ft head, capable of producing in excess of 19,000 hp at full head; is of vertical-shaft, single-runner, Francis type with plate-steel spiral casing.

Motor. 13,450-hp, 80-percent power factor leading, vertical two-bearing synchronous motor operating at 164 rpm. Runaway speed in reverse is 210 rpm. Basis of comparison of bids was an efficiency of 96 percent. Each additional horsepower saved was evaluated at $92.50.

Pump. Discharge capacity is not less than 804 cfs when operating at 120-ft head and at an efficiency of not less than 88 percent; bronze impeller.

Butterfly Valve. d-c motor operated from station battery to close within 2 min in case of power failure.

Additions or extensions to existing facilities usually create more problems than the construction of a completely new project, and this was no exception. Because of the length of time required to install the third generator and pump, the operation of the Buchanan Power Plant could not be discontinued except for short periods of time when absolutely necessary.

Tailrace Excavated

Additional excavation of the Buchanan tailrace was necessary to assure an abundant supply of water for the pump as Inks Lake is lowered, and also to reduce the tailwater elevation at Buchanan during three-unit operation. Since Buchanan Dam is located on solid granite, the excavation required skill and knowledge in the use of dynamite and other explosives. Pins were set up at various strategic locations in the powerhouse and near the buttresses of the dam to measure the vibrations caused by the explosives.

Removal of the north wall of the original powerhouse was necessary so as to attach the addition to the building. The wall had to be removed without damaging existing equipment or the part of the building that would remain. This wall was of reinforced concrete ranging in thickness from 12 to 36 in. The use of hydraulic spreader jacks was not successful, and a large part of the wall had to be removed by suspending a large iron ball from a cable and allowing it to swing as a pendulum to break the concrete by impact.

The headgate was shipped completely assembled and weighed approximately 18 tons. This gate was loaded on a pontoon barge, which the Authority had purchased a few years ago from Navy surplus, and transported to the intake tower for installation. The penstock, which was installed in sections and welded, terminates in a Y at the powerhouse. One leg of the Y goes to the turbine of the third generator and the other goes to the pump through a butterfly valve in series.

The coils for the stators of the generator and motor were assembled in the field by the manufacturer. The turbine and pump were installed under the supervision of factory erection engineers.

A serious detailed study was made before a final decision was reached for the following reasons:

1. It is one of the first major installations of this type in the United States and extensive experience data were not available.
2. The Authority is a public agency subject to public criticism if funds are not expended on a sound economic basis.
3. The additional equipment had to be provided within a limited period at a reasonable installation and operating cost.
4. The Authority is not supported by either state or federal appropriations, but must pay operating costs out of revenues and must finance physical expansion through the sale of interest-bearing revenue bonds.

The installation of the motor and pump unit separate from the generator and turbine unit was the most economical and feasible arrangement for the Buchanan plant at the time the decision was made. Neglecting the loss in the penstock, the efficiency of the turbine and generator is 88.9 percent and that of the pump and motor is 86.3 percent. Another advantage of the two-unit plant is the possibility of operating the pump motor as a synchronous condenser during peak-load hours as conditions may require. By closing the butterfly valve and continually depressing the water in the pump by air, the motor operates efficiently as a condenser.

Pump Operated Successfully

The pump has been in operation since September 25, 1950, and no serious operating problems have arisen. An interesting operating development occurred on December 24, 1950, when an exciter and field failure caused a complete shutdown of the single-unit Inks Plant for six weeks. By careful operation of the pumping unit at the Buchanan plant whenever steam energy was available from any source, and by reduced operation of the Buchanan generating units, no water went over the spillway at Inks Dam during this period.

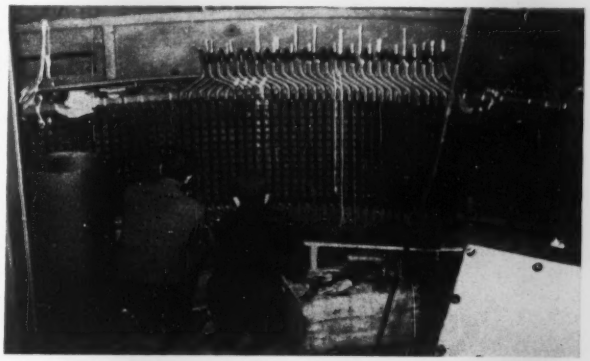
The total cost of the installation, based on a full-head capability of 14,000 kw, is approximately $115.00 per kw.

Future developments of the reversible pump turbine coupled to a generator so designed as to act as a synchronous motor when reversed may result in higher efficiencies. Such installations should definitely reduce the initial cost. However, careful consideration and study will be necessary to determine whether this reduction in first cost is sufficient to offset the higher operating costs resulting from lower efficiencies.

Equipment manufacturers are creating national interest in pumped-storage operation through the development of various types of units that will result in lower installation costs and higher efficiencies. A number of proposed plants will no doubt become economically feasible as a result of this research.

Interconnected operation of large transmission networks is continually developing a greater need for peaking capacity. Since much peaking capacity is more readily available from hydro plants, increased hydro generation, supplemented by pumped storage, should give the answer in many instances.

The constant increase in the number of large generating units driven by high-pressure, high-temperature steam turbines creates a desire for additional off-peak load to obtain more favorable load-factor operation. This is a favorable situation for the development of pumped-storage installations.



COILS FOR STATOR of 13,450-hp Westinghouse pump motor were installed on job.

Houston Sludge Disposal Plant profits from

Ready fertilizer markets and other favorable

local conditions cut annual sludge disposal costs

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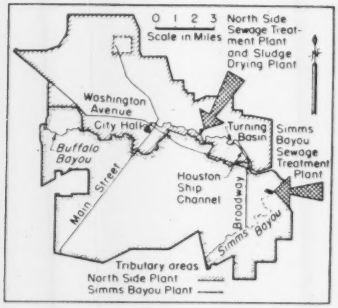


FIG. 1. TRIBUTARY AREAS of North Side and Sims Bayou Sewage Treatment Plants embrace all of Houston (except for areas annexed early this year).

DISPOSAL OF sludge from Houston's two main sewage treatment plants had already become a problem in 1947, at which time the writers were engaged to make a study of the situation and prepare a report. The report, submitted in November 1947, was followed by authorization, the following April, of plans and specifications for a sludge disposal plant, also prepared by the writers. Contracts were let in 1948 and 1949; preliminary operation of the plant started in August 1950; and acceptance tests and final completion are scheduled for April 1951.

The investigation of methods suitable for the disposal of sludge in Houston, Tex., included six projects for the disposal of raw sludge and five projects for the disposal of digested sludge. For Houston conditions, it was found more costly to dispose of digested rather than raw sludge and therefore the sludge digestion projects were rejected. The six proposals for the disposal of raw sludge and the estimated net total annual cost of each were as follows:

1. Dewatering raw, wet sludge on vacuum filters and hauling the sludge cake to a distant site for disposal—$268,000.

2. Dewatering raw, wet sludge on vacuum filters, drying the sludge cake and selling the dried product as fertilizer—$83,330.

3. Dewatering the raw, wet sludge on vacuum filters, incinerating the sludge cake, and hauling the ash to a distant site for disposal—$367,120.

4. Pumping the raw, wet sludge to lagoons constructed at a distant site—$100,550.

5. Barging raw, wet sludge to deep water in the Gulf of Mexico for disposal—$443,960.

6. Using existing sludge lagoons at the North Side Sewage Treatment Plant to maximum capacity, and dewatering the remaining raw, wet sludge on vacuum filters, drying the sludge cake and selling the product as fertilizer—$57,420.

The study resulted in the recommendation of project or method No. 6, which was adopted. It included the pumping of raw sludge from the Sims Bayou Plant to the North Side Plant, construction of a dewatering and drying plant for producing fertilizer, and construction of storage facilities for the dried product. The estimated cost of the recommended construction was $1,394,000, and the final cost will be about the same.

It was realized that risks and uncertainties are involved in the processing and sale of sludge, since the lower net annual cost of this method of disposal depends on the sale of fertilizer at a favorable price. It was stated in the engineer's report that, "If the City is prepared to enter the business of manufacturing and selling fertilizer, we believe this to be the most favorable method of sludge disposal."

Local Conditions Favor Method

There are several favorable factors in Houston which were considered to be important:

1. A sludge drying plant had been operated by the city for many years and thus considerable experience had been acquired in the drying and marketing of sludge fertilizer.

2. Lagoons for the disposal of raw sludge had been used for many years with considerable success. The con-

use of existing facilities

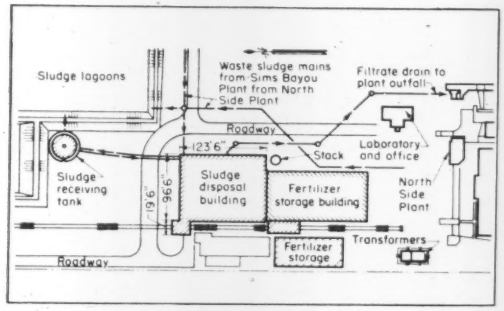


FIG. 2. SLUDGE DRYING PLANT receives sludge through force mains from North Side Plant and Sims Bayou Plant in sludge receiving tank, which serves as surge and thickening tank. Sludge conditioning equipment, filters and dryers, are in sludge disposal building.

HOUSTON'S new sludge disposal plant, operating full scale since February 1951, cost $1,367,171. Annual operating cost is low—$57,420—because of favorable local conditions taken advantage of in design. Important among these factors was feasibility of using sludge lagoons and other facilities of nearby North Side Sewage Treatment Plant.

clusion was that some quantities of raw, wet sludge could be disposed of in these existing lagoons during short peak periods and also when the drying equipment was out of service for overhaul and repair. These two factors much reduced the cost of the sludge drying plant.

3. Good markets for dried sewage sludge exist within reasonable distances. These include rice growers within 50 miles of Houston and truck gardeners in the Rio Grande Valley, in Georgia, and Florida. The demand seems to be fairly well distributed throughout the year, the needs of the rice growers running from January to May, and those of the truck gardeners from May to December. Few municipalities have such a favorable combination of local conditions.

Plant Provides for Population Increase

The plant has been designed to serve a population of 776,310, as compared to the 1950 population of 594,321, thus providing for an increase of about 31 percent. As of 1960, the quantities of dry solids, in tons per day, based on an annual average, were estimated as follows:

Total dry solids for disposal	61.9
Quantity to be disposed of in lagoons	− 9.9
Quantity available for fertilizer	52.0
Chemicals added	+ 3.1
Total dry solids	55.1
Loss in drying	− 1.1
Dry solids as fertilizer	54.0
Residual moisture in dried product	+ 6.0
Total fertilizer	60.0

The actual quantity of raw solids that will be disposed of in existing lagoons cannot be estimated very closely, and in any event will not be large, especially during the early years of operation, and will depend largely on the period required to overhaul the sludge drying equipment. The design capacity of this equipment is based on estimated conditions in the year 1970 so that the lagoons will be used infrequently and mostly in emergencies.

The average annual quantity of dry sewage solids to be disposed of in 1970 was estimated as 71.0 tons per 24 hours. To handle this quantity, it was estimated that the sludge drying equipment should have a capacity to evaporate 24,000 lb of water per hour, divided equally between two units with no spare or reserve unit.

Characteristics of Sludge

The sludge to be disposed of is raw preliminary sedimentation-tank sludge and excess activated sludge from two large sewage treatment plants of the activated sludge type. The North Side Plant is the one at which the sludge disposal plant is located, and the other, the Sims Bayou Plant, is approximately seven miles southeast of the North Side Plant. (See Fig. 1.) The sludge from Sims Bayou is pumped through an 8-in. force main to the North Side Plant. The sludges from the two plants are mixed in a common surge and thickening tank and then delivered to the dewatering filters.

The new sludge disposal plant (Fig. 2) is composed of the following major elements: (1) Sludge force mains from the Sims Bayou Sewage Treatment Plant and from the North Side Plant, (2) a raw sludge receiving tank which serves as a surge and thickening tank, (3) facilities for conditioning the raw sludge with chemicals, (4) a dewatering plant consisting of four vacuum filters, (5)

TABLE I. CONSTRUCTION COSTS OF SLUDGE DISPOSAL PLANT

Item		Total Cost	
		Estimated	Actual
Raw Sludge Pumping Station at Sims Bayou Plant		$22,000	*
Sludge force main			
32,700 ft @ $6.75		220,000	
35,922 ft @ $4.78			171,710
Dewatering plant	$189,000		
Drying plant	541,000	1,109,000	1,148,053
Fertilizer storage	79,000		
Trucks and trailers		22,000	†
Miscellaneous		21,000	47,408
	Totals	$1,394,000	$1,367,171

* Built as part of the Sims Bayou Sewage Treatment Plant.
† Not purchased at this time.

TABLE II. ESTIMATED TOTAL ANNUAL COST FOR 1960

Item		Annual Amount
Administration		$ 11,800
Labor		69,400
Power		11,200
Fuel		35,040
Chemicals		91,100
Maintenance, repairs and replacements		42,480
	Total for operation	$261,020
Debt service		64,400
	Total annual cost	$325,420
Revenue from fertilizer		268,000*
		$ 57,420

* Revenues from fertilizer were estimated at a sale price of $12.25 per ton of dried product. The city of Houston has a contract to sell all the product up to June 1951, at $16.00 per ton in bulk, f.o.b. the plant.

a sludge drying plant consisting of two driers of the flash type, and (6) storage facilities for about 1,100 tons of dried product, equivalent to 16 days' capacity at the estimated 1970 average rate of production.

The facilities in (3), (4), and (5) were provided in a new sludge disposal building (Fig. 2), and those of (6) were provided in an existing building remodeled for the purpose.

The sludge force mains are cast iron, 8 in. in diameter. The main from the Sims Bayou Plant is 35,922 ft long, and that from the North Side Plant, 550 ft long. At the Sludge Disposal Plant, these mains are arranged and valved so that the raw sludge can be delivered either directly to the lagoons, to the sludge disposal building, or to the sludge receiving and thickening tank.

The sludge receiving and thickening tank is 40 ft in diameter and has a water depth of 12 ft 3 in. at the outside diameter. Its capacity is 116,000 gal, which provides a displacement period of about 1.9 hours for the estimated 1970 average quantity of raw sludge. Dorr equipment is used for removing the bottom sludge.

Chemical Facilities Made Flexible

Because of uncertainty at the time of design as to the availability of ferric chloride for raw sludge conditioning, the chemical storage and feeding facilities were made sufficiently flexible to permit use of either ferric chloride or ferric sulphate. These facilities include mechanical car unloading and conveying equipment for delivering hydrated ferric sulphate to a large overhead storage hopper, four dissolving and mixing tanks for preparing the ferric sulphate solution, five tanks for the storage of ferric chloride or ferric sulphate solution, a pneumatic system for transferring liquid ferric chloride from tank cars to the storage tanks, and chemical feed and control equipment. A single dosing flume is provided in the sludge disposal building. In this flume both the rate of chemical dosing and the rate of sludge feed to each of the four filters can be independently controlled.

Each of the four vacuum filters of the dewatering plant is 16 ft long and 11.5 ft in diameter. Each filter has a rated capacity of 1,270 lb of dried sludge solids per hour, and all four are required for the estimated quantity of sludge in 1970. Because of the availability of the existing lagoons, no capacity is provided for peak quantities of sludge for reserve. Filtrate pumps were not used because of the feasibility of constructing a so-called barometric seal pit, from which the filtrate flows by gravity to the North Side Plant outfall.

Conveyors move the sludge cake from the vacuum filters to the sludge driers. Each of the two driers is designed to evaporate 12,000 lb of water per hour at a thermal efficiency of 50 percent. Preliminary operation indicated a considerably higher thermal efficiency so that more capacity is provided than was estimated to be necessary. This equipment is of the flash type and consists of furnaces, cage mills, vapor fans, mixers, screens, cyclones, conveyors, ducts, control equipment, a sludge cooler, and similar equipment. Natural gas is used as fuel.

The dried sludge is transported by conveyors and elevators to storage bins located in the existing sludge disposal building, which was remodeled and renovated. The storage bins have a capacity of about 1,100 tons. A system of belt conveyors and bucket elevators is provided to move the dried material to loading points, or from one bin to another if the material shows signs of becoming too hot.

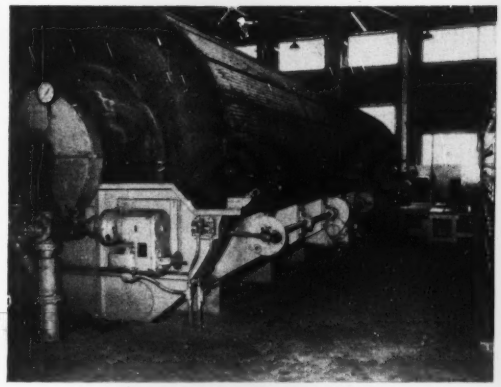
Raw Sludge Disposed of in Lagoons

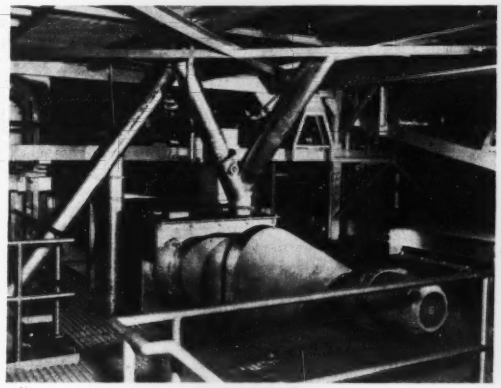
At the North Side Sewage Treatment Plant there were already in use sludge lagoons having a volume of 36.25 acre-ft. Many years of operating experience had indicated that raw sludge could be disposed of in these lagoons, under Houston conditions, at a rate of 100 tons of dry solids per acre-ft per year.

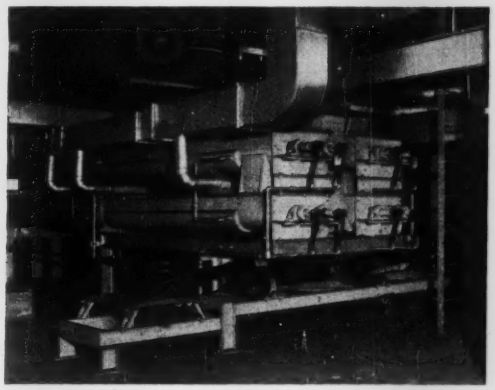
The capacity of these existing lagoons is thus about 10 tons of raw dry suspended solids per 24 hours. Since the total annual average production of raw solids to be disposed of, as of 1970, is estimated to be 71.0 tons per 24 hours, this leaves 61 tons to be disposed of by the dewatering and drying equipment. The estimated and actual cost of the various parts of the project are given in Table I. Annual maintenance and operation costs, as estimated for the year 1960, appear in Table II.

Alternate Bids for Driers Accepted

The contract documents for the sludge drying equipment permitted bids for either flash or rotary drum units. General drawings of the alternative types of drying equipment were prepared and included with the contract documents. Bidders were required to state and guarantee the cost of fuel and power required for the operation of their equipment and the loss of solids which they guaranteed not to exceed. The city reserved the right in comparing proposals and in awarding a contract to give consideration not only to the amount of the proposal, but also to the building size, the arrangement,







FOUR VACUUM FILTERS (top, left) dewater sludge, which is then carried by conveyor (top, right) to mixer (lower, left), where dewatered sludge cake is mingled with part of dried product before being introduced into flash drying system. Fertilizer cooler (lower right) reduces heat of finished product before it is placed in storage.

the general convenience and quality of the equipment and materials offered, and to the lowest total annual cost to the city in accordance with the guarantees and data submitted with the proposal and the operation and maintenance of the equipment. The only bid received was that of Combustion Engineering-Superheater, Inc., to which a contract was awarded in the amount of $355,720.

Plant Completed and in Operation

The sludge disposal plant was completed last fall and has been in preliminary operation since then. The tuning-up work and final tests are scheduled for April 1951.

For the most part, during the last few months, the raw sludge has been conditioned with Ferri-Floc bought from the Tennessee Corp. at $44.00 per ton, f.o.b. Houston. Ferri-Floc contains the following substances:

Substance	Percent by Weight
Ferric sulphate	66.50
Ferrous sulphate	5.44
Aluminum sulphate	6.00
Insolubles	4.00
Water	18.06
Total	100.00

Recently a local waste product has been tried out with considerable success. This waste contains about 10 percent of ferric chloride and some additional ferrous iron, which can be converted by chlorination to ferric chloride. The availability and use of this local waste may considerably reduce the cost of conditioning chemicals.

The Sludge Disposal Plant of the City of Houston promises to provide an economical method of sludge disposal since favorable local conditions were taken advantage of in the design of the project. In conclusion, the authors wish to thank J. M. Nagle, M. ASCE, and W. E. White, Assoc. M. ASCE, respectively Director and Chief Design Engineer of the Department of Public Works, for their helpful cooperation throughout the project and in the preparation of this article.

(This article is based on the paper by the writers which was presented by Mr. Turney before the Sanitary Engineering Division at ASCE's Houston Convention.)

Type of water supply influences location and layout of Texas steam-electric plants

STEAM-ELECTRIC generating stations require substantial quantities of water, principally for condensing the exhaust from the turbines. The sources of the water supply must be reliable and adequate, and the water must be of good quality. In many cases this necessitates chemical treatment or the rejection of sources not readily susceptible to treatment at moderate cost. The variable rainfall in Texas causes fluctuating stream flow, and variable groundwater conditions. Where a variety of sources of supply is available, the selection of a suitable plant site necessitates analysis of alternative types of condensing-water systems along with other factors.

For augmenting natural water supplies, artificial lakes and reservoirs have been constructed, to obtain adequate surface area for heat dissipation and to accumulate sufficient volume to make up for losses. Many newer plants recirculate the available water. This usually involves mechanical-draft cooling towers, with makeup supplied by surface water or by pumping.

The type and quantity of water available have considerable influence on the economics and design of steam-electric stations, as well as on their operation and maintenance. Problems arising from water-table fluctuations, reservoir control, flood flows, siltation and algae growth, as well as troubles developing in plant operation, tax the ingenuity of engineers and operators. This article is a condensation of the paper presented by the authors at the Houston Convention before the Power Division session.

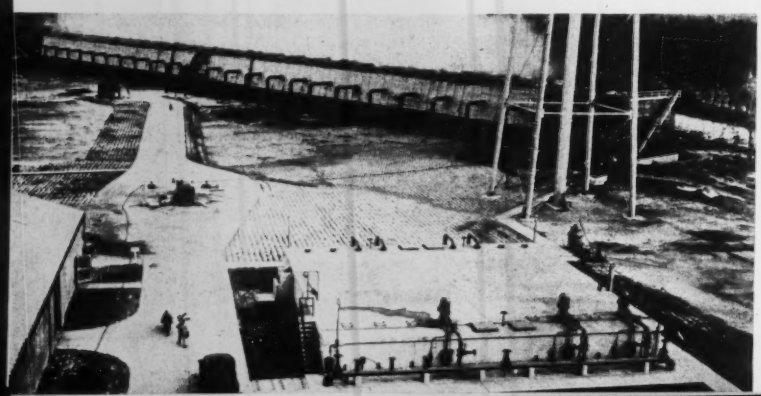
LOCATION OF a steam-electric station is ordinarily determined by the power load and transmission connections within the area to be served, as well as by sources of fuel. If tidewater or a large body of water is close at hand, the problem of water supply is relatively simple, but if the plant is inland or remote from larger rivers, the problem becomes complex. Adequate water supply of satisfactory quality for condensing, boiler makeup and other plant uses is a prerequisite that must be considered in preliminary surveys of site availability and in the ultimate decision as to plant location. Of course many other factors, such as transportation, proximity to housing facilities, land values and building restrictions, as well as general system requirements, enter into the selection of the site.

In Texas the average yearly rainfall varies from less than 10 in. in the western section to about 50 in. in the southeastern section (Fig. 1). However, flash floods of high intensity and short duration are common, and it is not unusual in some parts of the state for more water to fall within a few days than the average annual rainfall in the area.

Water from rainfall, remaining after evaporation and transpiration losses, replenishes underground supplies or becomes available as runoff in streams, rivers and lakes. Average yearly runoff varies from practically zero in El Paso and 1 in. in the western and Panhandle sections, to more than 10 in. in east Texas. Conservation and judicious use of underground water are necessary to prevent waste and depletion.

Natural underground reservoirs have some advantages over surface supplies, since they provide more uniform yield and are not materially affected by prolonged droughts. Groundwater is also relatively constant in temperature, and seldom varies in chemical character over a period of time. Much of the supply used for industries and utilities is from water-bearing beds of considerable depth and extent, with artesian or subartesian pressure flow

TWO PLANTS of Houston Lighting and Power Co. depend on water pumped from wells for makeup and on cooling towers for heat dissipation. Induced-draft 52-cell cooling tower for 132,000-kw Greens Bayou Station shown has capacity of 285 cfs. Clarification basin and one of three wells appear in foreground. Station is out of photo at left.



Water Uses in Steam-Electric Plants

The heaviest demand for water in steam-electric stations is as a cooling medium, to remove heat from the steam that is not converted into electric energy. For a modern high-efficiency plant, designed condensing-water flow usually ranges from 125 to 200 cfs per 100,000 kw of capability; older or less efficient stations normally use more water than modern installations. The quantity depends on plant efficiency, design of condenser, type of circulating system and in general, on the economics of the situation.

In addition to condenser requirements, water circulation is needed for removal of heat from electric generators, transformers and a variety of auxiliary equipment. This

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FIG. 1. RAINFALL in Texas generally increases from west to east. Map of rainfall belts shows normal precipitation in inches per year.

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requirement is usually of the order of 3 percent of the condensing-water flow. Condensing and service waters are, of course, recirculated when the quantity available is limited. In a cooling-tower plant, service water after use is normally carried to the tower basin, and is usually sufficient to provide all the cooling-tower system makeup required. For boiler feedwater makeup, to replace losses in the boiler-turbine-condenser circuit and in auxiliary equipment, the water requirement is very small as compared with other uses—of the order of 1 percent of the feedwater used. Other non-recoverable water is used for general service, including fire protection, janitor's cleaning, lawn sprinkling and the like, and water supply for sanitation and personal needs. These uses may aggregate several hundred cubic feet in 24 hours in a station of the magnitude of 100,000 kw.

Over-all consumptive use of water for a modern 100,000-kw steam station, with condensing water recirculated through a cooling tower, is frequently of the order of 5 cfs (2,250 gpm). However, depending on conditions, the use may be greater or less; measurements of make-up are seldom accurate. Stated in the units commonly used for expressing domestic and general consumption in a city, this is equivalent to about 3 mgd—sufficient to supply a town of perhaps 40,000 people. Use at this rate is within the capability of the well-water supply obtainable in most parts of Texas.

For the four utility systems in north central and western Texas with which the authors have been connected and which will have an aggregate steam-plant capacity of 1,800,000 kw after completion of additions now under construction or authorized, the total water requirements will be nearly 5,000 cfs. However, recirculating systems are provided for all but 10 percent of the condenser capacity.

There are very few natural lakes in Texas so located and of sufficient size to be suitable for condensing-water supply. In some cases, use for municipal water supply or recreational purposes precludes utilization for steam-plant requirements, although there is nothing in the use of water for condensers or general plant service that would contaminate it or make it otherwise unfit for public use.

Types of Condensing-Water Systems

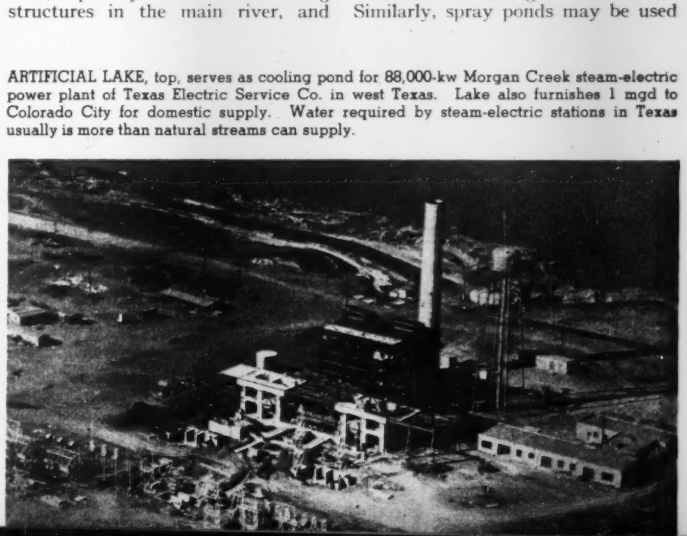
Artificial lakes, constructed to serve as cooling ponds for condensing water, are usually located on tributary streams or creeks, since the construction of a dam with sufficient spillway capacity across a main river is very expensive. Ponds must be of sufficient extent to provide adequate cooling surface and to possess storage capacity to compensate for evaporation, seepage and silting. Depending on the relative humidity and temperature of the air above the lake, and the velocity of the wind, the amount of this evaporation may be much greater than the rainfall on the lake surface. A lake or reservoir used as a cooling pond necessarily loses a little water through heat dissipation in addition or that lost by natural evaporation.

Under some conditions a cooling pond may be constructed in a low area, near a river having a minimum flow adequate to replace evaporation and other losses from the pond. This arrangement may avoid a costly dam, spillway and flood-resisting structures in the main river, and requires only a pump house and water line or canal to convey the makeup to the cooling pond.

A fairly large river is required to supply sufficient water for a large steam-electric plant, if it is used directly without recirculation. Assuming a requirement of about 500 cfs for a 300,000-kw plant, there are no rivers in Texas with sufficient flow the year round. The Brazos has one of the larger watersheds, and the reservoir system that has been proposed and partially developed for it will eventually provide a minimum flow of over 500 cfs. Several reservoirs have been built and others are under construction on the headwaters of the Trinity River, which will regulate and steady its flow, although it is not expected that the minimum will be increased to as much as 500 cfs. These upstream reservoirs will assist in controlling damaging floods and in maintaining great minimum flows.

On rivers whose minimum flow of record is less than that desired for plant operation, arrangements can sometimes be made to recirculate and cool the limited water available, so that full plant capability can be obtained through the dry season. An auxiliary cooling tower may be used to supplement water in the river, the required amount being recirculated through the tower. Similarly, spray ponds may be used

ARTIFICIAL LAKE, top, serves as cooling pond for 88,000-kw Morgan Creek steam-electric power plant of Texas Electric Service Co. in west Texas. Lake also furnishes 1 mgd to Colorado City for domestic supply. Water required by steam-electric stations in Texas usually is more than natural streams can supply.



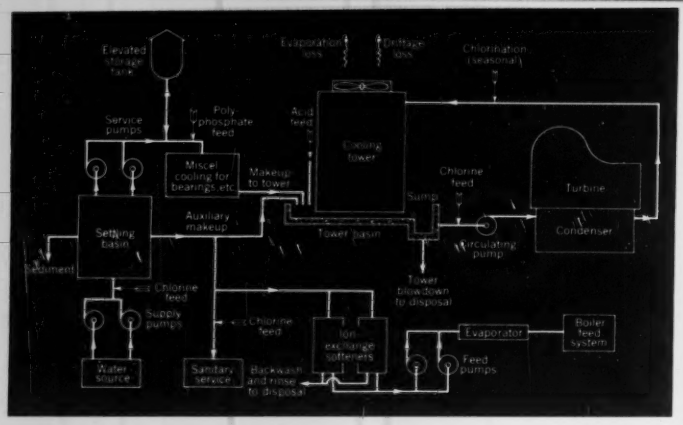


FIG. 2. TYPICAL water supply system for steam-electric generating station in Texas includes settling basin, elevated storage tank, cooling tower, chemical treatment facilities, and ion-exchange softeners for boiler feed system.

or spray nozzles may be located along a length of river banks adjacent to the power-plant site so that cooled water from the nozzles falls into the stream above the plant. With any of these arrangements, a low weir-type dam across the river is usually necessary to provide suction facilities. The dam may be placed some distance below the plant site, to create a pond in which intake and suction are separated by a considerable distance, thus providing for cooling and recirculation of the limited natural flow.

Where streams are unsuited for development with reservoirs or artificial lakes employing recirculation, they may still be used to supply makeup water for a cooling tower or spray pond. Spray ponds are sometimes less expensive to construct than towers, but have considerably higher water losses resulting from windage, and give insufficient cooling during calm periods in hot weather. For this reason, most recent installations of this type use mechanical-draft cooling towers, the induced-draft type being generally preferred.

In Texas a large part of the steam installations away from the coast utilize cooling towers, for which groundwater generally provides makeup water. The development of the modern cooling tower has made it possible to locate stations economically with respect to load, transmission, fuel and transportation requirements.

Typical Water Supply Systems

An example of an artificial lake, in this case used both as a cooling pond for a steam plant and for municipal water supply, is that provided at Morgan Creek Steam-Electric Station of the Texas Electric Service Co. on the stream so named, near its confluence with the Colorado River in west Texas. Average annual rainfall in this area is about 21 in., and records show the possibility of a prolonged drought with an average rainfall of only 11 in. This would require about 24,000 acre-ft of storage to compensate for evaporation, silt deposit and seepage.

In addition to serving the steam plant, the lake can provide over 1 mgd for domestic use in Colorado City. A study of the runoff characteristics of the 258-sq-mile watershed was made to determine the safe yield of the reservoir and to make sure that it would not be depleted during a critical drought. At present two units with a total capacity of 44,000 kw are installed at this plant and an additional 44,000-kw unit is scheduled for 1952 operation.

Illustrating the case of an artificial lake constructed in a low area near a river, but at an elevation considerably above the stream bed, is the arrangement adopted for the Trinidad Plant of the Texas Power & Light Co. in north-central Texas. Here a pond of 750 acres in area was created by a long, low dike with only a small regulating spillway, and with makeup pumped about a mile from the Trinity River. The natural configuration of the ground produces a very effective circulating system. At present, about 188,000 kw in turbine capacity is installed at this plant, and there is no evidence of undue temperature rise from recirculation.

At the Dallas Steam-Electric station of the Dallas Power & Light Co., the installation of a new 66,000-kw unit with a cooling tower called for the drilling of two wells to the Travis Peak sands, about 2,800 ft deep at this location, with a normal pumping capacity of 1.9 cfs (850 gpm) and variable-speed motors to permit pumping 2.9 cfs (1,300 gpm) under emergency conditions. These wells supplement the present wells which serve a spray pond and cooling towers for 100,000 kw of capacity. At the new Parkdale site in East Dallas, about 5 miles east of this location, two similar wells are proposed, but because of the dip in the Travis Peak sands, the wells will be about 3,200 ft deep.

Two so-called "dry-land" steam stations in south Texas, both belonging to the Houston Lighting & Power Co., depend entirely on cooling towers for water recirculation to dissipate the heat from condensers. West Junction, with four turbine units in service by 1951, giving over 225,000 kw of net capability, has two towers each rated at 82 cfs and a third tower designed for 318 cfs. The total circulating flow is thus in excess of 450 cfs, or about equal to the minimum river flow expected after completion of improvements in either the Brazos or the Trinity River basins.

At Greens Bayou Station, completed in 1949 with two turbine units aggregating over 132,000-kw capability, a single tower rated at 285 cfs supplies the entire condensing-water requirements. The water system includes a clarification basin, three deep-well pumps, and a 52-cell induced-draft cooling tower. For both stations the water supply for tower makeup and for all other uses is derived from groundwater.

Cooling Ponds and Towers

A cooling pond will ordinarily provide good service if heat carried into the pond with the condenser discharge does not exceed a unit value of the order of 100 Btu per sq ft of water surface per hour. With that condition, the average temperature of water from pond to plant may exceed the average dry-bulb air temperature by 10 F. Any specific case must be analyzed by itself, taking all conditions into account. However, a lake area of about a square mile, under average Texas conditions, is adequate for a modern plant of 250,000 to 300,000 kw, assuming that extended circulation of the water is fairly effective over the area.

With a cooling-tower installation, the water supply needed is very small as compared with the normal direct-circulating condensing-water requirement. Average consumption for a cooling-tower plant is of the magnitude of 3 percent of that for direct condensing with the discharge not recirculated. For instance, for a modern 100,000-kw cooling-tower

plant with a condensing-water flow of 175 cfs, the makeup water may be 5 cfs. Losses to be made up depend on heat input to the tower, amount of air circulated through the tower and its temperature and humidity, and on blowdown required.

The type of tower construction influences the amount of spray carried off with the leaving air, the driftage usually being estimated at 0.2 percent of the water circulated. Ordinarily there is gradual concentration of the solids coming into a circulating-water system with the makeup water; consequently, the tower must be "blown down" to reduce solids concentration to a point such that serious scaling of the condenser tubes, with resulting poor heat transfer, is avoided. The water required for blowdown may reach 10 percent or more, and is frequently a large element in the makeup required.

Recourse to a cooling tower occasions several penalties, which must be considered in determining the type of condensing system. Condensing water obtained from a cooling tower may average 5 to 10 deg F warmer than that from a large lake or river in summer, and this may increase to 20 or 30 deg F in winter. The higher water temperatures may cause reduction in efficiency of power generation by about 1 to 1.5 percent. In addition, an increase in power use by the plant auxiliaries is to be expected, first because the circulating-water pumps require more power for pumping water over the cooling tower, and second because the power used by fans for forcing air through the tower is considerable. Usually an increase amounting to around 1.5 percent of power generated may be expected for this additional auxiliary power, giving a total net increase in plant heat consumption, and a decrease in plant net capability, of from 2 to 3 percent.

The service-water system can generally be so designed that the water discharged from bearings and coolers in the power plant is collected and returned for use as makeup for the circulating-water system. This quantity may equal or exceed the tower makeup requirements.

Limitations on water characteristics are governed chiefly by only two factors—protection of structures and equipment against erosion and corrosion, and prevention of deposits that impair heat transfer. Temperature of supply is a prime consideration for all heat-dissipation applications in steam plants; on the other hand, it is of negligible importance for the boiler feedwater makeup, which invariably receives both chemical and thermal treatment to meet the severe requirements for low content of dissolved solids and gases.

TO SUPPLY WATER for 188,000-kw Trinidad Plant of Texas Power and Light Co., in north-central Texas, artificial lake one mile from Trinity River is replenished by pumping from river. Intake and discharge canals for condensing water appear in foreground.

Water Purification Methods and Controls

Since water use in steam-electric plants serves mainly as a medium for heat dissipation, the principal objectives in water treatment are to avoid scale deposits and fouling with organic matter, and to obtain protection against corrosion. Water supplies therefore are chosen with regard to the character of their impurities, and to the applicability of low-cost and dependable corrective treatment. The substances to be controlled include principally calcium, magnesium and sodium, usually in the form of bicarbonates, sulphates and chlorides, and to a lesser extent nitrates and sulphides.

The flow of water and points in the plant at which treatment is applied for a typical cooling-tower steam station, are shown in Fig. 2. Because of the substantial effect of water conditions on plant performance and maintenance, water treatment often becomes an important duty of the operating staff. Automatic devices are provided for chemical feed and for cycling of intermittent processes, and in addition the sampling and analysis of water are carried on continuously under the direction of a specialist. Treatment of boiler feedwater is a major responsibility of the specialist, since in modern boilers the dissolved solids content must be controlled within close limits and with regard to the complex chemical reactions that occur at the high steam pressures and temperatures now employed.

Performance of steam plants with respect to both fuel economy and avoidance of forced outage depends as much on the operation and maintenance of the water supply and utilization facilities as on any other plant function. In spite of vigilance and the application of experience derived in overcoming past difficulties, new conditions often arise which tax the ingenuity and judgment of operators.

Operating conditions that require vigilance include sudden clogging of intake screens with aquatic growths or schools of fish, reduced yield from deep wells because of sand movement or collapse of shutter screens, delignification of wood in cooling towers, and corrosion or pitting of metals in condenser tubes, heat-exchangers, piping, pumps and other equipment. Close supervision is also needed in the operation and maintenance of water-treating apparatus, including devices for injection of chlorine compounds, polyphosphates, acid and other substances.

Disposal of waste water from steam stations is seldom difficult, because the volume is usually moderate and because constituents in the wastes comprise only the substances removed from the raw makeup water and the residuals from water-treating reagents. Where required by the terrain or other conditions within the drainage area or affecting "downstream" water uses, sedimentation basins arranged for intercepting solid matter are provided. Sanitary-waste disposal is by means of a conventional septic tank and tile field when a public sewer cannot be utilized.

The authors are indebted to associates in the consulting engineering division of Ebasco Services Incorporated for their aid in the preparation of this paper; also to the operating staffs of the utility companies mentioned for the information given.

Power to pay for Brazos River Development

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CONSERVATION of water is of prime importance to the continued development of agriculture and industry in Texas, especially in the Brazos River Basin, the largest of the six intrastate river basins in the state, which drains about 17 percent of the state's area (Fig. 1). Rice growing on the flat lands of the lower basin and heavy industrial development along the Gulf Coast near the river's mouth, have increased the demand for stored water as well as for electric power.

The projects under way or planned by the Corps of Engineers on the lower Brazos have the primary and essential function of flood control and will also provide power and conservation storage. Dams to regulate low-water flow on the upper Brazos are being constructed by the State of Texas through its agency, the Brazos River Conservation and Reclamation District; these projects are designed to produce sufficient power revenue to pay all operating costs and to amortize the entire costs of the development within thirty years after completion of the program.

The Brazos River rises on the high plains near the New Mexico border, flows in a southeasterly direction across the entire state of Texas, and enters the Gulf of Mexico at Freeport—a total distance of about 1,300 miles. The area of the watershed is 44,600 sq miles, of which 9,240 sq miles, on the somewhat arid high plains, is considered non-contributing.

It is notable that in the upper watershed, where the topography is rugged and where there are many good reservoir sites, the average annual rainfall is only 25 in. and the minimum only half this much. In the lower basin, however, where the topography is either flat or gently rolling, the average rainfall is 50 percent greater and the dry periods are less protracted.

Torrential rainstorms occur frequently on nearly all parts of the river, and resulting runoff frequently causes devastating floods in the lower reaches. Because of topographic conditions, the storage regulation of the Brazos presents rather unusual problems, since most of the reservoir sites where a larger volume of storage can be economically provided will neither control the major floods on the lower river nor provide a large volume of regulated low-water flow.

In 1935 the Ambursen Engineering Corp., in collaboration with the Texas State Board of Water Engineers, developed for the Brazos River Conservation and Reclamation District a plan comprising the construction of 13 dams (9 with powerhouses) on the Brazos and its tributaries. Possum Kingdom Dam and powerhouse, which has been in service 10 years, was the first of these constructed. The total capacity proposed in 1935 was 41,700 kw for the Possum Kingdom project, in combination with the Turkey Creek, Inspiration Point, and

FIG. 1. BRAZOS RIVER BASIN, draining about 17 percent of Texas, is largest in state. Rainfall in upper part of basin where good dam sites exist, averages only 25 in. yearly. In lower part of basin, where terrain is low and rolling, rainfall is 50 percent greater and dry periods are less protracted.

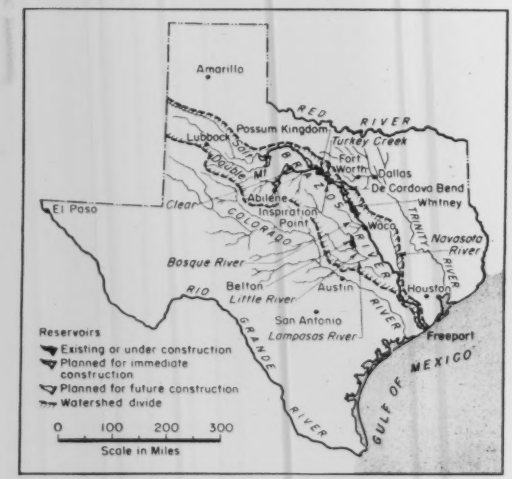
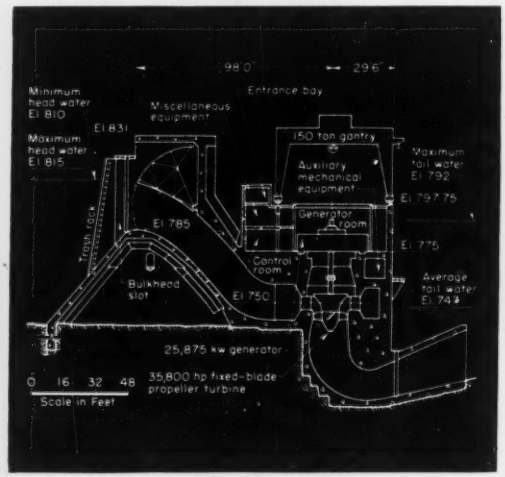


FIG. 2. POWER PLANT at Inspiration Point on Brazos River has turbine rating of 36,400 hp at net head of 61.5 ft (full gate ratings at minimum head). Fixed-blade propellors are also planned for installation at Turkey Creek Project, since they are considered to have adequate efficiency over range of heads planned for.



De Cordova Bend projects, which had been selected as the next step in development. The annual primary energy estimated as available would have allowed operation at this capacity 45 percent of the time, so that it could have been used for base-load operation. The 1950 plan proposes an initial capacity at these four dams of 100,500 kw (more than double the 1935 proposal) and an ultimate capacity of about 195,000 kw. The estimated annual primary energy available will permit the initial capacity to be operated at full rating only 13 percent of the time.

Power Marketed Through Large System

To market this much electrical output with such limited hours of operation is possible only because of the existence of a large interconnected power system having a large peak-load demand and a preponderance of fuel generating capacity. Operation of hydro units can be coordinated with that of steam units, so that the hydro plants will carry the peak loads occurring during part of the day. This means that the hydro plants will be operating only four or five hours daily for possibly five days a week. Estimates indicate that the North Texas Interconnected System will be able to provide a market by 1956 for the additional hydro capacity proposed on the Brazos River in the 1950 plans.

Since completion of Possum Kingdom Dam coincided with the start of World War II, the District made no further immediate plans. After the war, the District decided to build those additional projects which would produce sufficient power revenue to permit financing by revenue bonds. Thus it was necessary for the proposed power output to be sold under a firm contract in advance of construction. The existing market for peaking power limited the salable output to about 80,000 kw.

The three projects best suited to immediate development were the Turkey Creek, Inspiration Point, and De Cordova Bend projects located on the stretch of the river between Possum Kingdom and Whitney (Fig. 1).

Each of the three proposed dams will be approximately 80 ft above the stream bed and will consist of earth embankments forming abutments for a central spillway section of the Ambursen type. For Turkey Creek and Inspiration Point Dams the power intake structure will form a section of the dam adjacent to the spillway, with short, formed, water passages through the intake structure connecting with a concrete scroll case (Fig. 2). The De Cordova Bend Dam is located on the upstream side of a very large bend in the course of which the river falls 20 ft. A short canal will be excavated across the neck of the bend diverting water to the powerhouse intake structure (Figs. 3 and 4), thereby providing a project head 20 ft greater than that available at the dam site.

Prolonged Droughts Complicate Operation

As previously mentioned, these three projects are provided with the necessary stream flow primarily because of the regulation afforded by the Possum Kingdom Reservoir. The most critical dry periods at Possum Kingdom have a duration of about four years, with the greatest storage depletion occurring at the end of approximately 40 months. By utilizing the full drawdown storage of 570,000 acre-ft, it is possible to obtain an average regulated outflow of 500 cfs over this critical period. The combined drawdown storage planned for the three proposed reservoirs amounts to only 147,000 acre-ft. If this storage were used over the same 40-month period as that at Possum Kingdom, it would serve little more than to compensate for the additional evaporation losses resulting from these reservoirs.

Since the inflow of the river between Possum Kingdom and De Cordova Bend has frequently been zero for periods as long as three months, it appeared at first that only the regulated outflow from Possum Kingdom could be considered in determining the primary energy production of these projects. However,

FIG. 3. KAPLAN-TYPE TURBINE will be installed at De Cordova Bend power plant because of wide range of operating heads. Turbine is rated at 47,000 hp at 67.5 ft (full gate rating).

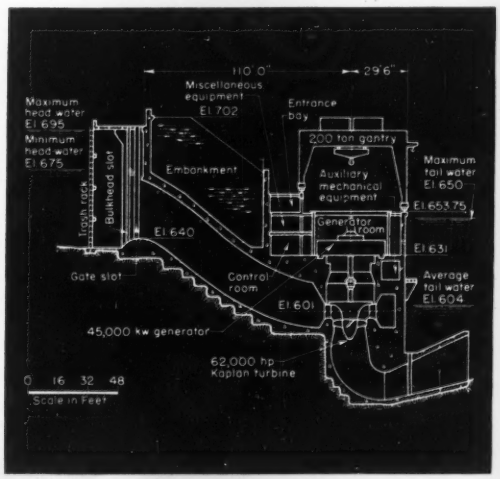


FIG. 4. AT DE CORDOVA BEND PROJECT on Brazos River, short canal across neck of bend diverts water to powerhouse intake, thereby providing 20 ft more head for development at site.

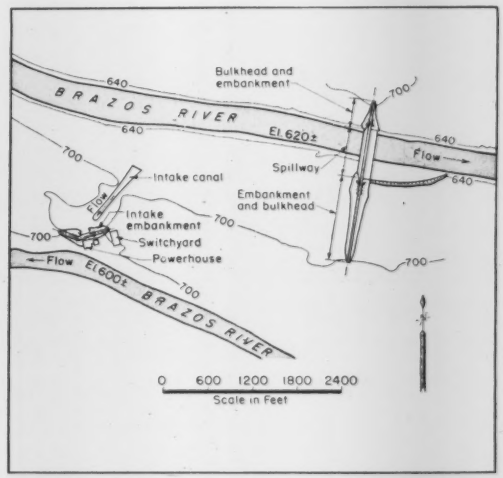


TABLE I. PRINCIPAL DATA FOR THREE PROPOSED DAMS ON BRAZOS RIVER

	Turkey Creek	Inspiration Point	De Cordova Bend
Drainage area, sq miles	13,560	14,035	16,410
Elevation, ft:			
Top of gates	876.0	815.0	695.0
Minimum power pool	872.0	810.0	675.0
River bed (approx.)	804.0	740.0	625.0
Net head, ft:			
Minimum (except during floods)	58.5	61.5	67.5*
Average or normal	60.5	65.5	81.5
Reservoir volumes, acre-ft:			
Top of gates	114,000	165,000	160,000
Drawdown storage	18,000	29,000	100,000
Length of dam, ft:			
Spillway (same for all, with 16 gates 36 x 30)	636	636	636
Intake and bulkhead	287	307	184
Embankment	539	497	1,391
Total	1,462	1,440	2,211
Turbines:			
Number (same for all)		—1 initial and 1 future—	
Type	Fixed prop.	Fixed prop.	Kaplan
Horsepower, full gate	30,000	34,500	47,000
Net head,* ft	55.5	59.5	67.5
Generators:			
Rating, kva, 60-deg rise	21,256	25,000	43,478
Rating, kw, 80-deg rise	22,000	25,875	45,000

* Minimum heads during floods

further study of the stream-flow characteristics over 26 years of continuous records at two gaging stations, indicated that the dry periods for the 3,000 sq miles of drainage area between Possum Kingdom and De Cordova Bend are never so protracted as those for the 13,350 sq miles of drainage area above Possum Kingdom. Therefore, an operating procedure for the four reservoirs was found possible which would allow use of the storage in the three reservoirs downstream from Possum Kingdom over a shorter period than must be considered for Possum Kingdom. In this way the lower reservoirs could be filled during later stages of storage depletion at Possum Kingdom, so as to provide a regulated flow for primary energy production at De Cordova Bend 50 percent greater than that available at Possum Kingdom.

Without describing the proposed method of reservoir operation in detail, it should be noted that it involves withdrawal of water from Possum Kingdom at a variable rate. This rate is determined not only by the requirements of operating Possum Kingdom at a uniform plant factor with varying head, but also by the necessity of supplying flow deficiencies at downstream plants. Such operation inevitably requires a shifting of the relative positions of these plants on the load curve, and also requires that the deficiency in capacity, which occurs at Possum Kingdom during the lowest head, be compensated for by excess capacity available at downstream plants during such times.

As a result of studies based on this method of operation, the total primary energy for the four-dam system is estimated to be 116,000,000 kwhr per year. The average division of this total among the four plants for the most critical period is approximately as follows:

Possum Kingdom	31,000,000 kwhr
Turkey Creek	22,000,000 kwhr
Inspiration Point	23,000,000 kwhr
De Cordova Bend	40,000,000 kwhr
Total	116,000,000 kwhr

The four power plants would have a range of from 1,000 operating hours per year at Turkey Creek up to 1,380 at Possum Kingdom.

Based on construction costs prevailing early in 1950, the combined cost of the three projects, including substations and transmission interconnections, is estimated to be $26,500,000. This amount includes cost of reservoir property, construction overhead, a contingent allowance, and interest on the principal amount during construction.

All Plants Centrally Controlled

For economy both in initial investment and in operating cost, the design provides for remote control of all three plants from a central point, using carrier current for the supervisory control and telemetering operations. The factors contributing to the feasibility of this control method on the project are: (1) The necessary apparatus has now been perfected; (2) these three power plants, all located within relatively short distances of each other, are readily accessible from a central point; and (3) the plants can be connected to transmission lines to be constructed at the same time as the power plants.

Operation of the three plants will be centered at a control building, in which the main executive and engineering offices of the Brazos River District will ultimately be housed. This building will also provide space for a hydrology and reservoir operation department.

The central control room will provide a panel for each of the three generating units and space for future expansion of the system. The apparatus provided will permit starting, stopping, or motoring the units; voltage and power factor regulation and switching; and also will give remote indication of faulty operation of the most important equipment at each plant.

Operation of the plants in this manner will not only allow a reduction in operating personnel but will also make possible a very economical arrangement of the power plants. All control equipment at each plant will be set into the upstream wall of the generator room, so that the only superstructure required will be two small floors on the upstream side of the unit bay.

In the preliminary investigations for the Turkey Creek, Inspiration

Point, and De Cordova Bend projects, and in the studies for the two other projects between Possum Kingdom and Whitney Dams, considerable thought was given to the possibility of providing pumped storage both at these projects and at Possum Kingdom Dam. The use of pumped storage appeared to be an attractive expedient to permit the utilization of inflow to the Brazos River downstream from Possum Kingdom for the production of primary energy, without using stored water to compensate for the short-time deficiencies in this inflow. For example, if pumping facilities were installed at De Cordova Bend, water could be pumped back into the reservoir during periods of deficient inflow between Possum Kingdom and De Cordova Bend, using energy available at off-peak hours of the week. In this manner the reservoir could always be kept practically full, so that the dependable capacity and the power output could be increased 20 to 30 percent for the same stream flow. Similar considerations apply to the other reservoirs.

The studies and estimates relating to the use of pumped storage were carried far enough to establish fairly well the amount of pumped storage required, the cost of providing it, and the results it would accomplish. Considerable study was also given to the efficiency and relative merits of different types of installations. Recommendations were made to the District by the Ambursen Engineering Corp. for a complete development of this type to replace the three projects as discussed above.

Such a development would have resulted in an increase in the dependable capacity of new projects from the 78,000 kw now planned, up to approximately 130,000 kw. One objection to the plan was the fact that this is a fairly large block of hydro power to be absorbed in the surrounding area at one time. Another objection was that the development would have required the initial construction of four projects instead of three, and would have allowed the use of pumped storage at only two of them, because of the need for an afterbay downstream from each pumping installation. For these reasons, the decision was merely to make provision for the future installation of pumped storage and to proceed with the initial development on the basis of the three projects already discussed.

If the pumped-storage installations are made after upstream storage has been provided and the system load has increased sufficiently to utilize a larger amount of peaking capacity, it is expected that a fourth reservoir, to be known as Bee Mountain, between De Cordova Bend and Whitney Dams, and a fifth reservoir, to be known as Hightower, to develop the remaining head between Inspiration Point and De Cordova Bend, can be added to the system. This arrangement would allow the use of pumped storage at Possum Kingdom and at all the additional reservoirs except Bee Mountain. Then only the Possum Kingdom and Bee Mountain reservoirs would require any appreciable fluctuations in level for storage purposes, since all the power plants would be generating and pumping during approximately the same hours.

It is evident that such an installation would minimize the problems of reservoir operation previously discussed, since the available downstream flow and storage would be a critical consideration only for the Bee Mountain Project. During periods of low stream flow, Bee Mountain could be operated only at the highest position on the load curve, and the storage requirements would thus be kept to a minimum. It might be feasible to pump at Bee Mountain also, but it appears at present that this would require too great a change in both the power and flood control operation of Whitney Dam.

Four main types of installation were considered in studying the possibility of pumping:

1. Separate motor-driven pumps.
2. Units with a turbine and pump impeller on the same vertical shaft as the generators. When pumping, the generator would act as a motor with the same speed and direction of rotation as when generating.
3. A reversible pump-turbine coupled to a generator so designed that when reversed and acting as a motor it would have a slower speed than when generating.
4. A reversible pump-turbine coupled to a generator which would operate at the same speed when acting as a motor as when generating.

Conclusions on Pumping Study

Tentative conclusions were drawn regarding these installations, as follows:

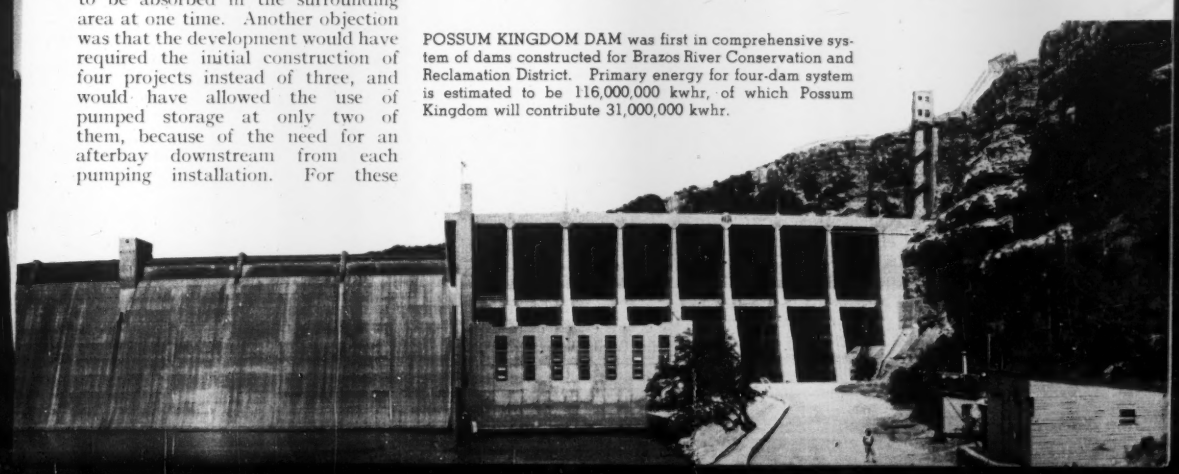
1. The separate pump installation requires intake and powerhouse structures nearly as large as those for a generating unit, and the provision of one such pumping unit for each generating unit would almost double the installation cost per kilowatt. It did not appear that the benefits would justify such an addition to the project cost.

2, 3. Both the second and third types of installations listed involve additional cost—for equipment or structures or both—of such magnitude as to outweigh the small gain in efficiency to be expected.

4. There is sufficient data on both models and prototypes for reversible turbines of the fourth type listed to indicate that in the relatively near future such an installation should be feasible and reasonably efficient.

After weighing all these factors, it was decided to design each of the three projects so that a reversible pump turbine coupled to a single-speed generator can be installed in the future unit bay.

(This article is a shortened form of the paper presented by Mr. Marks before the Power Division session presided over by Milton G. Salzman at ASCE's Houston Convention.)



POSSUM KINGDOM DAM was first in comprehensive system of dams constructed for Brazos River Conservation and Reclamation District. Primary energy for four-dam system is estimated to be 116,000,000 kwhr, of which Possum Kingdom will contribute 31,000,000 kwhr.

International irrigation developments along Rio Grande started

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THE RIO GRANDE is one of the great rivers of the West. It rises in the State of Colorado and flows for about 400 miles across the State of New Mexico until it reaches El Paso-Juarez. Here it becomes the boundary line between the United States and Mexico for a distance of about 1,240 miles to its mouth in the Gulf of Mexico. (See Fig. 1 of following article by J. C. Bustamante).

The Water Treaty of 1944 between the United States and Mexico, which became effective November 8, 1945, settled the long-standing problem of the national ownership of waters of the international Rio Grande and provided for the construction of the international works for the conservation of its waters and their utilization to the maximum benefit of the two countries. Briefly, the treaty provides for conservation in international storage reservoirs and equitable distribution between the two countries of the entire flow of the river below Fort Quitman, including an average of more than 3,000,000 acre-ft which otherwise would continue to waste annually into the Gulf of Mexico, largely in the form of floods. The division of the international waters of the Rio Grande will work out, when full development is achieved, on about a fifty-fifty basis.

About 90 miles below El Paso-Juarez, near Old Fort Quitman, the river enters a canyon section which in effect forms the division between what we may term the upper and the lower basin. This article concerns only the lower basin, which is the part of the river covered by the Water Treaty. Practically all the waters in the upper basin are consumed therein so that only about 150,000 acre-ft per year passes Fort Quitman and enters the lower basin.

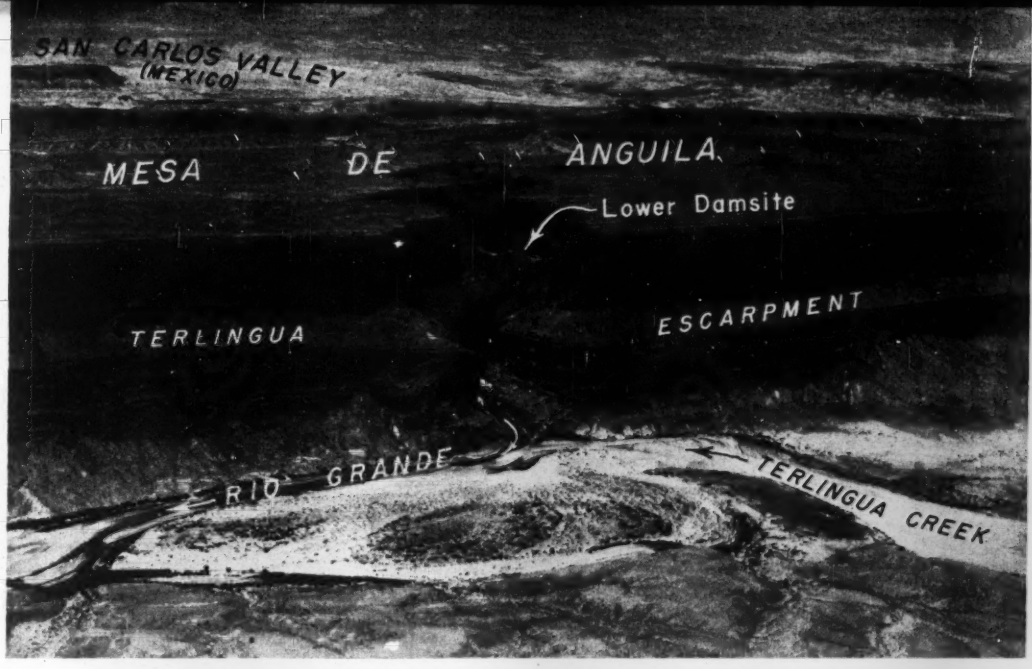
From Fort Quitman to the mouth of the Rio Conchos, a distance of about 200 miles, irrigation development is not extensive, but possibilities of future development are being studied. (See profile, Fig. 1, page 40.)

The flow of the Rio Grande after replenishment by the Conchos, averages about 1,300,000 acre-ft per year. There is a limited irrigation development in both countries in the narrow valley immediately below the mouth of the Conchos. Here the river enters its main Canyon Section, which includes the Big Bend area and extends almost 400 miles downstream from the Conchos. The flow at Del Rio near the lower end of the section averages 2,700,000 acre-ft per year, having been augmented by the two more important American tributaries, the Pecos and the Devils River. There is practically no irrigation within this reach.

Through the Canyon Section there exist many dam sites, including those in the famed Santa Helena Canyon, where the almost vertical walls are about 1,500 ft high: the Mariscal, the Boquillas, the Reagan, Panther Gulch, Agua Verde, Rattlesnake and Diablo. The fall of the river through this reach amounts to over 1,600 ft. At potential sites practically all this fall could be developed by a series of dams for the production of electric energy. If an average flow of 2,000,000 acre-ft per annum is assumed, the energy potential amounts to nearly 450,000 hp.

The International Boundary and Water Commission is making an intensive study of the geology of this region and of the many possible sites for dams and their costs and characteristics. A concrete gravity dam 420 ft high at or above Agua Verde to store $4\frac{1}{2}$ million acre-ft, and a rock-fill structure 175 ft high at the Diablo site to store $1\frac{1}{2}$ million acre-ft, are being given serious consideration.

For the next 300 miles, the river flows in what is known as the Hill Country. Within this reach the river receives inflows from many side streams, and the average flow increases to 3,700,000 acre-ft per year at the lower end of this section. Within this reach about 66,000 acres of land in the two countries are irrigated from the river. A 150-ft dam at Sullivan Springs would develop power but, because of evaporation losses, the reservoir would conserve no water.



FAMED SANTA HELENA CANYON of the Rio Grande has nearly vertical walls about 1,500 ft high, contains many favorable dam sites.

Below the Hill Country the river enters its delta region and flows for another 250 miles to its mouth in the Gulf of Mexico. In this reach it is joined by two Mexican tributaries, the Rio Alamo and the Rio San Juan. Below the mouth of the Rio San Juan, the river flow averages about 4,500,000 acre-ft a year, and at the Lower Brownsville Gaging Station, which is near the last main diversion from the river, the flow amounts to about 3,000,000 acre-ft per year.

Under present conditions, this 3,000,000 acre-ft wastes into the Gulf of Mexico. It is this water that can be largely conserved by the construction of the storage reservoirs on the main stream provided for by the Water Treaty. Within this reach lie the highly developed Lower Rio Grande Valley in the United States and its equally large and fertile counterpart in Mexico which is rapidly being developed. There are presently irrigated in this area in both countries about 750,000 acres. The assured and regulated water supply to be provided by Falcon and the other reservoirs contemplated on the Rio Grande will strengthen the economy of the area and permit limited expansion in the United States and considerable expansion in Mexico.

Construction of Falcon Dam and Power Plants, first of the large international storage dams and hydroelectric plants to be built on the Rio Grande, was started in December of last year. The dam is a multiple-purpose structure for conservation of water, flood protection and generation of hydroelectric energy. It is being constructed jointly by the two governments through their respective sections of the International Boundary and Water Commission, of which L. M. Lawson is Commissioner for the United States, and David Herrera Jordan is Commissioner for Mexico.

Reservoir Capacity 4,100,000 Acre-Ft

The site is about 75 miles downstream from Laredo and Nuevo Laredo (Fig. 1, page 42). The dam will create a reservoir with a capacity of about 4,100,000 acre-ft and a surface area of some 115,000 acres at maximum flow line. Upstream from the dam, for an axial distance of about 40 miles, the reservoir will average about 4.5 miles in width. Beyond this point it will be contained within the present river channel.

Of the approximately 4,100,000 acre-ft of capacity, 300,000 is reserved for dead storage, for minimum power head, and for silt detention; 2,100,000 acre-ft for conservation storage; and the remaining 1,700,000 acre-ft for flood control. The conservation storage capacity is divided between the two countries on the basis of the capacity required by each country for storage of water allocated to it: 1,230,000 acre-ft, or 58.6 percent, to the United States; and 870,000 acre-ft, or 41.4 percent, to Mexico. The regulated water supply to be provided by Falcon Dam is urgently required for the large areas of lands already developed in the Lower Rio Grande Valley of the United States, and by Mexico for the considerable area now under irrigation and the large areas under development on its side of the valley [as described by Mr. Bustamante in the article that follows]. Because of this urgency the Water Treaty requires that the dam be completed during 1953.

The estimated cost of Falcon Dam and power plants is about $46,000,000 exclusive of certain items to be borne separately by each government within its own territory, such as cost of land, construction camps, relocation of highways and utilities, and access roads. The estimated cost of the dam without power plants is $33,500,000, prorated between the two countries in proportion to the conservation storage capacity allocated to each. The additional cost of the power plants is about $12,500,000, borne equally by the two countries.

The cost of the construction of Falcon Dam and power plants is being divided between the two countries by allocating to the two sections of the Commission the performance of the various items of work on the basis of their estimated costs and in

the proportions stipulated by the treaty. The work is therefore divided into two schedules—Schedule No. 1, consisting of items allocated to the United States Section, and Schedule No. 2, consisting of those allocated to the Mexican Section. The work under each schedule is being performed by contract, under the supervision of the two sections. Specifications were issued by the Commission in both Spanish and English, including identical technical provisions, and legal provisions prepared by each section in accordance with the laws of its own country. Separate bids were requested on the schedule of work allotted to each section, in dollars for the work allotted to the United States Section, and in pesos for the work allotted to Mexico.

In the development of plans for Falcon Dam and power plants, both sections of the Commission have consulted freely with the interested agencies of their respective governments, particularly with the Bureau of Reclamation and the Corps of Engineers of the United States, and the Ministry of Hydraulic Resources of Mexico, as well as with some of the outstanding engineering consultants of both countries. The Bureau of Reclamation is performing the design work on behalf of, and under the supervision of, the two sections.

The dam is of rolled earth-fill construction with a total axial length of some 26,000 ft, of which about 10,000 ft is in the United States and 16,000 ft in Mexico. The crest of the dam, at El. 323.0 ft, is 35 ft wide and the maximum height above present river bottom is about 150 ft. The upstream slope is 3:1 with a 20-ft berm in the river section at El. 225, and thence a 4:1 slope to the original surface. The downstream slope is 2:1 to El. 250 and thence 4:1 to El. 190, where the slope breaks to 2:1 to the original ground surface. In the maximum section, the distance between the upstream and downstream toes of the dam is about 1,000 ft.

An oil-surfaced roadway and sidewalk will be constructed along the entire length of the dam, and a beam-type guardrail along both edges of the crest for protection of traffic. The dam probably will become an important international crossing connecting with the federal highway systems in both countries.

Spillway Designed for Super Floods

The spillway is located through the United States abutment about 1,400 ft from the left bank of the river. It is a reinforced concrete structure of conventional design controlled by six 50 × 50-ft fixed wheel gates. The gate sills are at El. 256.7. The maximum design capacity of the spillway is 456,000 cfs when the reservoir water surface elevation is at 314.2 ft. The flood storage capacity in the reservoir is sufficient to limit the discharge of all floods which have occurred during the past 50 years to a maximum spillway discharge of 60,000 cfs and the additional capacity provided by the spillway will pass a "super flood" nearly three times larger than has ever occurred during the period in which records are available, without causing failure of the dam.

Separate outlet works are provided for each country. The United States outlet works consist of a concrete gravity dam section adjacent to the spillway, in which are embedded three 13-ft penstocks through which water is admitted to the turbines or bypassed to the river channel below. The upper end of the penstocks is protected by a trashrack structure and admittance of water to the penstocks is controlled by fixed wheel gates. The required capacity of the outlet works is 4,500 cfs.

The Mexican outlet works consist of a 22-ft-dia penstock whose upper end is located in a conventional-type tower structure. Water is admitted to the single penstock through a single fixed-wheel gate. At the lower end, the single penstock terminates in a manifold section with the water passing through the turbines and bypass line to the river. The outlet works are designed to provide a capacity of between 3,500 and 6,500 cfs, depending on the stage of the reservoir.

Additional outlet capacity for either country can be made through the spillway whenever the reservoir is above the crest—El. 256.7 ft.

The power plants, one on each side of the river, are near the downstream toe of the dam and are practically identical. Each contains three vertical-shaft, single-runner, Francis-type turbines, each of which will develop 14,750 hp at a rated head of 100 ft, and three 3-phase, 60-cycle, vertical waterwheel generators rated at 10,500 kw, 6,900 v. While each plant has a centralized control room and separate and independent facilities, the two will be interconnected for transfer of electric energy from one to the other.

It is estimated that the Falcon power plants will generate annually about 200,000,000 kwhr of prime energy and 50,000,000 kwhr of secondary energy. Under the Water Treaty this energy will be divided equally between the two countries. Provision is made in the treaty whereby

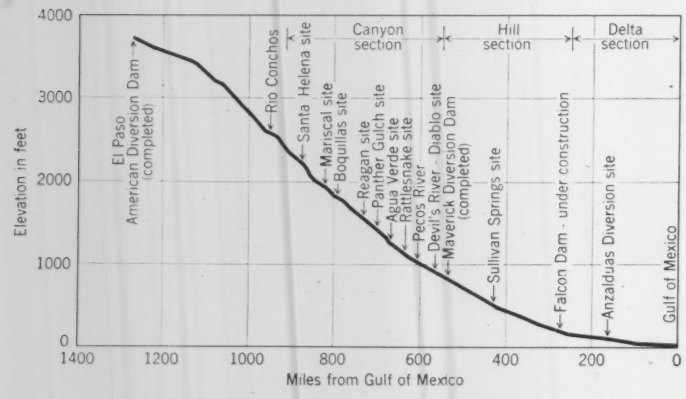
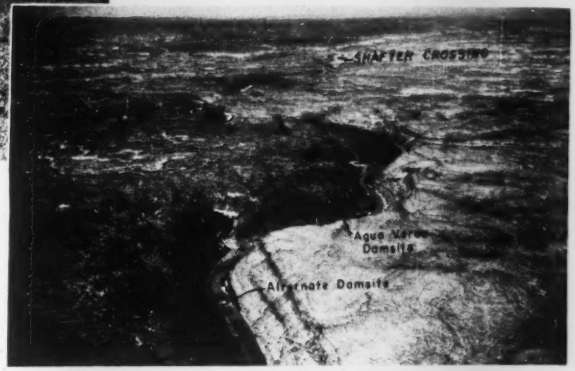


FIG. 1. PROFILE of Rio Grande from El Paso to Gulf of Mexico shows principal dam sites proposed and developed.



DAM 175 ft high, of earth or rock fill at Diablo site, would create recapture reservoir for power dams upstream, and control floods, especially from Devils River. Concrete gravity dam 420 ft high at Aqua Verde site would store 4½ million acre-ft.

under special agreements between the two governments, power belonging to either country and not required by it may be exported to the other.

Concrete aggregates will be obtained from two deposits, one in the Chapeño area on the United States side just downstream from the dam, and the other in the Mexican Terrace area on the Mexican side, just upstream from the dam. Two aggregate and concrete mixing plants will be installed, one for the concrete in each schedule. Embankment materials will be obtained from these same two deposits, from the excavations, and from other borrow areas.

Riprap for both schedules will be obtained from sources in Mexico. Extensive search failed to find a deposit of suitable riprap rock within a shorter haul than the Cerralvo Deposit, about 55 miles from the dam site. This deposit contains beds of good limestone.

The foundation for the dam is a relatively hard sand or silt stone which will be trenched to provide cutoff against underflow. Concrete core walls under the embankments are not needed. Cement grouting under spillway and powerhouse structures is specified but it is anticipated that the formation will take little grout.

The completion date for both schedules of Falcon Dam is October 3, 1953, which is just 35 days earlier than the treaty date of November 8, 1953. The construction program has been developed to meet this requirement, and the period of 1,050 days allowed seems practicable of achievement unless there are unprecedented floods or it is impossible to secure deliveries of materials.

The plan for diversion and care of the river suggested in the specifications calls for all embankment except that in the river section, and all structure work to be completed to El. 285 by October 15, 1952. In the river section, a 500-ft opening with 4 : 1 side slopes will be left. Shortly after October 15, 1952, a temporary cofferdam will be built and the river flow diverted through the 22-ft penstock of the Mexican Power Plant structure. In the Rio Grande a maximum flow from November to April of about 4,000 cfs can reasonably be expected.

As soon as the closure has reached El. 235, the 5-year frequency flood can be readily handled. This work should not take more than 50 days, or until January 7, 1953, and by April 10 the dam embankment should be up to El. 270, which would handle the 10-year frequency all-year flood. At elevations above 256.7, water can pass through the spillway. After the closure, the rest of the construction will be rushed to completion.

Assuming that the program works out as scheduled, that the river flow is sufficient to supply the irrigation demand, and in addition to fill the reservoir to about the spillway crest, some stored water can be delivered during the latter part of 1953.

(The original paper on which this article is based was presented by Mr. Ainsworth at the ASCE Convention in Houston before the Irrigation Division Session, at which W. E. Blomgren presided.)

Falcon Dam—for international flood control, irrigation and power

Engineering and construction	International Boundary & Water Commission, U. S. & Mexico
Design	U. S. Bureau of Reclamation
Type	Rolled earth
Length	26,000 ft
Height	150 ft above the stream bed
Crest elevation	323 ft above sea level
Spillway capacity	456,000 cfs
Power	Two 31,500-kw plants
Turbines	Three in each plant, 14,750 hp, vertical Francis type
Output	Prime, 200 million kwhr per year; secondary, 50 million kwhr per year
Reservoir	4,100,000 acre-ft
Earthwork	30,000,000 cu yd
Riprap	400,000 cu yd
Concrete	300,000 cu yd
Reinforcing steel	15,000 tons
Gates, valves, penstocks	7,500 tons
Cost: Dam	$33,500,000
Two power plants	$12,500,000
Contractor	Falcon Dam Constructors and Constructora Intercontinental S.A., each consisting of same six U. S. contracting firms headed by C. F. Lytle Co.
Construction period	1,050 days
Work begun	December 1950
Completion date	November 1953

Falcon Dam stimulates irrigation in Mexico

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International Boundary and Water Commission, Mexican Section, Cuidad Juarez, Chihuahua, Mexico

THE RIO GRANDE, which constitutes the boundary between Mexico and the United States from Cuidad Juarez–El Paso to its mouth in the Gulf of Mexico, is an uncontrolled stream. Although there are storage reservoirs on the main stream, and on the main tributaries on both sides of the International Boundary, as listed in Table I, they afford only a minimum control. The Rio Grande still has flows as variable as those that occurred in 1948, when a discharge of 600 cfs recorded at the Rio Grande City gaging station on June 24, 1948, was followed four days later, on June 28, by a discharge of 145,000 cfs. The Rio Grande City gaging station is at the entrance to the Lower Rio Grande Valley. The flood originated in the basin of the Devils River and the discharge recorded at the gaging station at Del Rio was almost 477,000 cfs.

These great changes in discharge have made it very difficult to develop irrigation projects in the large areas of suitable land which are found on both sides of the Lower Rio Grande. It is necessary not only to have the water available at the right time for irrigation, but also to protect the planted lands against floods.

The Water Treaty of February 3, 1944, between the United States and Mexico provides for the construction of several international storage dams and reservoirs on the Rio Grande. Of these the lowermost, and the first to be constructed, is Falcon Dam, located about 72 miles below Nuevo Laredo, Mexico, and Laredo, Tex. The construction of this dam is already started (see preceding article in this issue, by C. M. Ainsworth; also item in the December 1950 issue, page 60) and the studies to determine the best sites for the dams upstream are being continued by the International Boundary and Water Commission.

As has been mentioned, the Lower Rio Grande Valley contains large areas of good agricultural lands. On the Mexican side, inside the Reynosa-Matamoros–San Fernando triangle, in the State of Tamaulipas (Fig. 1), there are about 1,000,000 acres of first-class lands that have been sparsely cultivated mainly by dry farming, where the crops are dependent on a suitable amount of rain at the proper time. Prior to the building of levees along the river and of the floodways on the Mexican side, the river overflowed every year flooding most of the lands laying between the river and the Monterrey-Matamoros railway and leaving them covered with a layer of fertile silt and well saturated with moisture. The farmers took advantage of these favorable conditions to do their planting, running the too frequent risk of an extemporaneous flood which might ruin their crops. Approximately 25,000 acres were cultivated under these perilous conditions.

Apart from the lands subject to inundation, about 25,000 acres were cultivated which were dependent on the rains for a crop. After the levees and floodway channels were completed in 1938, ways were sought to provide irrigation for the lands subject to flooding. For this purpose the Retamal Canal was built to divert water from the Rio Grande by gravity into a natural depression which was improved with a levee in its eastern side so as to form Culebrón Reservoir, later extended to the south to form the Palito Blanco Reservoir (Fig. 1).

With the Retamal Canal and Culebrón and Palito Blanco Reservoirs, it has been possible little by little to develop an irrigation system which, at the end of 1950, included some 65,000 acres. New population centers have developed, and old ones have grown

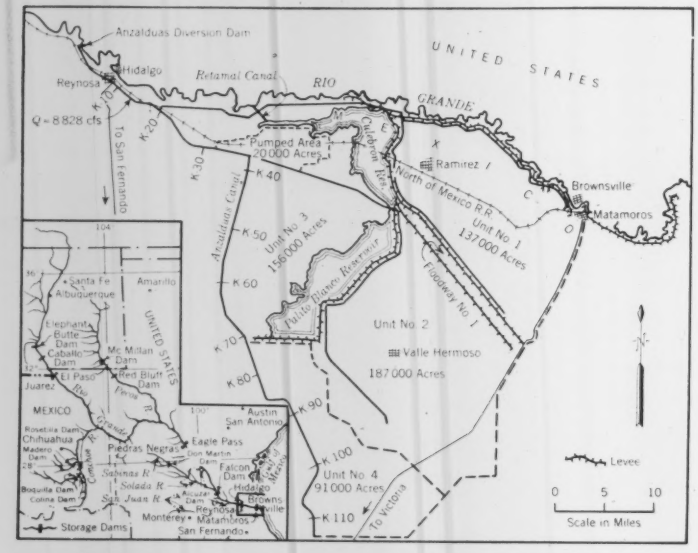


FIG. 1. LOWER RIO GRANDE VALLEY contains large areas suitable for irrigated crops such as citrus fruit and vegetables, and especially cotton. To utilize that part of Falcon Reservoir storage allotted to her, Mexico has planned Lower Rio Bravo Irrigation System of 575,000 acres, divided into four units.

ANZALDÚAS CANAL is being excavated in two steps. First, initial prism is cut to full depth (right) with tractor-drawn scrapers hauling spoil to dumping areas. This initial cut removes about 50 percent of total earth volume. Then draglines (far right) extend initial prism to full canal width, and shape banks. Section shown, between Kms. 29 and 30, is lined with clay on slopes and bottom because of presence of sand lens.

In addition to the irrigated lands, some 250,000 acres are at present dry farmed. These are scattered over the area suitable for cultivation. Altogether, this part of the Lower Rio Grande Valley produced around 240,000 bales of cotton in 1950, while the irrigated area in the Lower San Juan River system produced an additional 100,000 bales. The Falcon Dam when completed will appreciably regulate the erratic flow of the Rio Grande, will provide a dependable water supply for irrigation, and will protect the flood control works, thus providing a good foundation for the extension of irrigation both in Mexico and in the United States.

To utilize that part of the Falcon Reservoir storage which the Water Treaty allots to Mexico, together with the flow of the Alamo and San Juan Rivers and returns from the Lower San Juan Irrigation System, Mexico has planned the Lower Rio Bravo Irrigation System, with a net area of approximately 575,000 acres divided into four irrigation units, as shown on the map, Fig. 1.

The water supply for this irrigation system will be from a gravity intake on the Rio Grande, utilizing the flood control diversion dam which the International Boundary and Water Commission has proposed for the Anzaldúas site on the river. Water will be released from Falcon Reservoir and will flow in the river channel to the diversion dam. It will enter the Anzaldúas Canal through a gravity intake located normal to the axis of the diversion dam at its western abutment.

The Anzaldúas Canal will follow the general direction of the Rio Grande, will cut through the city of Reynosa, and at Kilometer 20 will divide into two branches. The main branch will extend to the south-southeast. The second branch will follow the river, cross the Retamal Canal, and skirt the Culebrón Reservoir. At Kilometer 40 the main branch will divide and a branch will extend toward the east. The Culebrón and Palito Blanco Reservoirs will function as regulating reservoirs.

The third unit of this irrigation system will include 20,000 acres of high lands which cannot be irrigated by gravity flow, and which will require pumping. Plans include a pumping plant near the town of Rio Bravo, approximately at Kilometer 34 on the Anzaldúas Canal.

The Anzaldúas gravity intake structure will be of reinforced concrete, normal to the axis of the Anzaldúas Diversion Dam. It will have six radial gates, each 19.7 ft wide by 14.8 ft high. These will be electrically operated. Provision will be made for stop-log closure. The Anzaldúas Canal in its first 3 miles will be 138 ft wide at the bottom with side slopes of $1\frac{1}{2}$:1. The longitudinal slope, s, will be 0.00010, and with a water depth of 16.4 ft, the discharge will be 8,828 cfs. Excavation for the canal is practically complete for the first 25 miles, and construction of the intake will begin early in 1951, with the hope that the intake and part of the canal can be placed in service by May 1, 1951, even though by that date the international diversion dam at Anzaldúas will not be built.

In order to pay for the Anzaldúas Diversion structure, intake and canal, the lands benefited have been assessed $32.75 per acre (at the present rate of exchange), to be paid in annual installments with 4 percent interest on the unpaid balance. The time allowed for payment will vary with the size of the benefited lands. Assessments on plots up to 50 acres may be paid in 20 years; those on plots of 50 to 125 acres must be paid in 15 years; and those on extensions of more than 125 acres must be paid in 10 years. Contracts with the Ministry of Hydraulic Resources have been signed by the land owners and have been entrusted to the Bank of Mexico. The Bank of Mexico, as trustee for the Government, has issued bonds which have been bought by the land owners and by interested industrial concerns, thus furnishing the funds for the construction of the Lower Rio Bravo Irrigation System.

Excavation contracts for the Anzaldúas Canal are held by two companies—La Victoria y Asociados, S. A., and Construcciones Hidráulicas, S. A. Constructora Cuauhtemoc, S. A., has the contract for the canal structures. No contracts for the intake or diversion structures have as yet been awarded.

(Mr. Bustamante's original paper, on which this article is based, was presented before the Irrigation Division, with M. E. Blomgren presiding, at the ASCE Convention in Houston, Tex.)

TABLE I. STORAGE RESERVOIRS IN RIO GRANDE BASIN

Of capacities exceeding 15,000 acre-ft at spillway level

IN MEXICO

Name and River	Capacity, Acre-Ft
Boquilla, Rio Conchos	2,116,000
La Colina, Rio Conchos	21,900
La Rosetilla, Rio Conchos Basin	15,400
Francisco I. Madero (Las Virgenes), Rio Conchos Basin	344,600
Centenario and San Miguel, Rio San Diego Basin	19,900
Venustiano Carranza (Don Martín), Rio Salado	1,123,000
Marte R. Gómez (El Azúcar) Rio San Juan	876,400
Culebrón and Palito Blanco, State of Tamaulipas	228,000
Total in Mexico	4,745,200

IN UNITED STATES

Rio Grande, Rio Grande, Colo.	51,100
Continental, Rio Grande, Colo.	26,700
Santa María, Rio Grande, Colo.	43,600
Terrace, Rio Grande, Colo.	17,700
Mountain Home, Rio Grande, Colo.	20,100
Sánchez, Rio Grande, Colo.	103,200
Costilla, Rio Grande, N. Mex.	15,700
El Vado, Rio Grande, N. Mex.	200,300
Bluewater, Rio Grande, N. Mex.	43,500
Elephant Butte, Rio Grande, N. Mex.	2,197,600
Caballo, Rio Grande, N. Mex.	346,000
Alamogordo, Pecos, N. Mex.	132,200
MacMillan and Avalon, Pecos, N. Mex.	43,500
Red Bluff, Pecos, Tex.	310,000
Willacy, Pecos, Tex.	25,000
Total in United States	3,576,200

PROPOSED

Falcon (under construction), Rio Grande, Mexico & U. S.	3,300,000
In or near Agua Verde (under study), Rio Grande, Mexico & U. S.	4,500,000
El Cuchillo (above Marte R. Gómez), Rio San Juan, Mexico	400,000
San Antonio, Rio Florido, Rio Conchos Basin, Mexico	200,000

New York State Thruway to be paid for by special license fees

Cost for 535-mile length estimated at $450,000,000

BERTRAM D. TALLAMY, Assoc. M. ASCE

Chairman, New York State Thruway Authority, and Superintendent, New York State Department of Public Works, Albany, N.Y.

FINANCING of the New York State Thruway rests on the old principle of bonding, but with a new application—amortization through the sale of special licenses for Thruway use. The Thruway Authority is convinced that this financial plan is the most equitable that could be devised. The $450,000,000 cost of construction and the operation costs will thereby be distributed among those who use it, now and in the future.

When the legislature first authorized the Department of Public Works to proceed with plans for Thruway construction, the superhighway was to be financed by funds made available each year for highway work. Two years and $65,000,000 later, it was apparent that the Thruway could not be built without seriously impairing construction and maintenance programs for other state highways. In 1945, when Governor Thomas E. Dewey recommended that the new super-road be self-liquidating, a conventional toll system was considered. The idea was discarded, however, after a committee of engineers found that toll collection would be expensive and inconvenient.

To Be Financed by Bond Issue

New York State's expressway is now the special province of the Thruway Authority, which is responsible for its construction and operation. The Authority is by law empowered to issue bonds up to $500,000,000, but to date most construction has been financed by the $65,000,000 made available by annual appropriations to the state budget, all of which is to be repaid. The 1951 legislature authorized an additional $60,000,000 loan with the stipulation that "any and all expenditures made from this appropriation shall be repaid to the state."

In September 1950, the Authority secured from private investors a loan of $10,000,000 at the exceptionally low interest rate of $1\frac{1}{2}$ percent. This loan permitted the transfer of the Grand Island bridges and the beginning of more than $8,000,000 of construction in their vicinity.

An amendment to the state constitution providing that state credit be pledged to Thruway Authority bonds will be referred to the voters in 1951. If approved, it will make possible an interest rate of 2 percent or less and eliminate the need for establishing reserve revenues. The reduction of required income from $28,000,000 to $16,000,000 will nearly cut in half the fees which would otherwise have to be charged for Thruway licenses.

Exact fees have not yet been determined, but will range from a relatively small amount for passenger cars to proportionately higher rates for commercial vehicles. Licenses will be issued on a yearly basis, although some convenient provision will be made for vacationing and out-of-state users. The licensing plan will become effective as soon as substantial lengths of the Thruway are completed.

To date, only 12.92 miles of the proposed 535 miles are open to traffic, and 64 miles more are under construction. Plans are complete or under way for 113.5 miles, and surveys are in preparation for another 127.

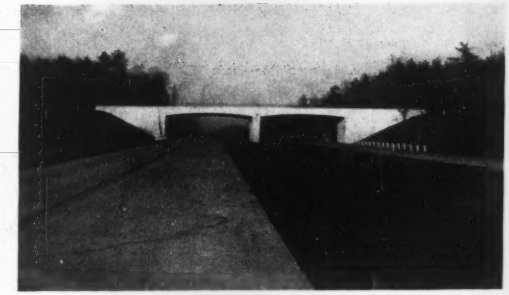
The Thruway was conceived as a part of a vast interstate highway network, and in answer to mounting traffic problems, state and national. Motor vehicle registrations in New York State have already topped the three million mark and are still rising. Street highways, many of them nearly 20 years old, are not equal to the terrific traffic burdens thrust upon them. Neglected because of the depression, the war, shortages of funds and emergencies, they are deficient on several counts—structure, design, safety, and capacity.

The remedy lies not in reconstruction and repair, although existing highways must necessarily be improved, but in a high-capacity highway, built on a new right-of-way and conforming to the most exacting standards of design and construction. It is not only a far-reaching solution to present traffic problems but a far-sighted provision for future ones.

Access control, the elimination of intersections at grade, and the provision of a safe, efficient artery for private and commercial traffic are the guiding objectives and determining factors in the Thruway design. Its features, however, do not differ markedly from those of many expressways in other states.

The Thruway will be entirely free of intersections at grade. Overhead structures or underpasses will carry all cross traffic, and special enter-leave lanes at least 1,200 ft long will feed and receive Thruway traffic. Adequate access to and from all major routes, as well as connections to the larger cities, will be provided.

The Authority is at present building two traffic lanes in each direction, one 12 ft wide, the other 13 ft wide,



OVERHEAD STRUCTURES and underpasses will eliminate all grade intersections and cross traffic on New York State Thruway. Overpass (above) is on completed section between Catskill and Saugerties.

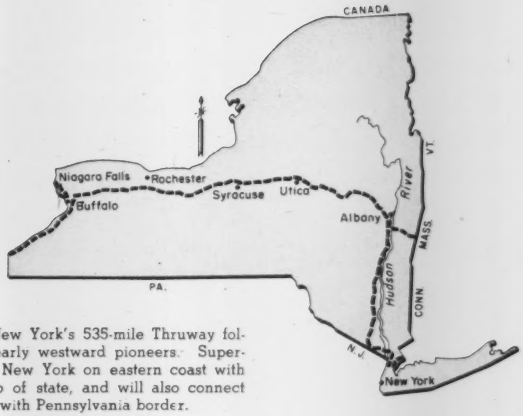


FIG. 1. ROUTE of New York's 535-mile Thruway follows historic trail of early westward pioneers. Superhighway will connect New York on eastern coast with Buffalo at western tip of state, and will also connect Massachusetts border with Pennsylvania border.

and two additional 12-ft lanes will be added in the mall as required, leaving a minimum mall width of 20 ft. The minimum width of right-of-way is 200 ft. Stabilized shoulders at least 9 ft wide are provided, giving a total minimum roadway width from shoulder to shoulder of 112 ft. Estimates indicate that the Thruway, when complete, will readily carry 40,000 vehicles daily, at any point and in each direction.

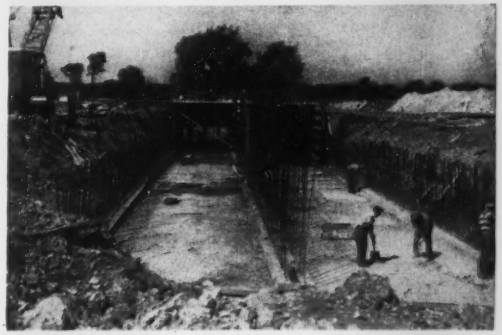
The minimum vertical and horizontal sight distance permitted is 1,000 ft; the maximum allowable grade is 3 percent; and the minimum radius of curvature is 2,800 ft. A mall varying from 20 to 150 ft or more in width, depending upon location, will separate opposing travel lanes. The pavement is a 9-in. uniform depth, reinforced concrete slab of about $1:1\frac{3}{4}:3\frac{1}{2}$ mix, with longitudinal and transverse joint supports for load transfer. The transverse joints occur about every 90 ft, and are placed on a varying depth of gravel arranged on an inclined plane with the greater thickness at the ditch side to permit drainage. Porous tile side drains of 6-in. diameter are covered with broken stone or gravel.

Materials used meet the standard specifications for all New York State highway work, with minor revisions to meet local conditions. Pavement cements are air-entrained portland, combined with natural in a ratio of $\frac{7}{8}$ portland to $\frac{1}{8}$ natural. For structures, Type 2 portland cement is combined with natural cement in the same ratio.

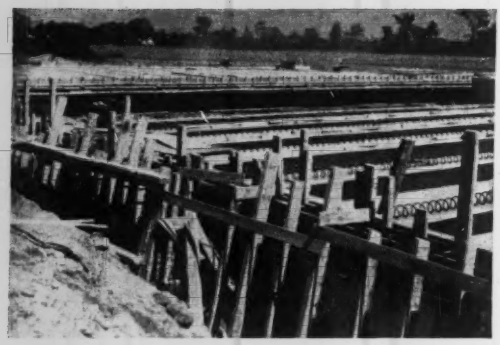
The proposed Hudson River bridge between Tarrytown and South Nyack will be a 1,100-ft tied arch across the navigation channel, the longest of its kind ever constructed. The main span will be 138 ft above water, and will cost about $50,000,000. (See CIVIL ENGINEERING for January 1951, p. 70)

The bridge piers will be founded on hollow, reinforced concrete caissons, the tops of which are below ebb-tide level. The caissons will be supported by 30 to 36-in. steel cylinders filled with concrete extending down to a sand and hardpan stratum. The caissons, which will be compartmented, will be towed to their positions and sunk on a prepared level bottom by filling them with water or sand and water. The caissons will be gradually dewatered as the super-

WAGON DRILLS prepare ledge rock for blasting on Thruway right-of-way. Elevations of ledge rock are determined by refraction seismograph, supplemented by actual drilling operations.



TWIN BOX CULVERT is erected to carry drainage under Thruway. For culvert structures Type 2 portland cement is used in combination with natural cement in ratio of 7 parts portland to 1 part natural.



FORMS are prepared for alpha beam on typical Thruway structure. Bridges along Thruway also include I-beam, plate-girder, concrete rigid-frame, and rigid-frame arch types. Largest structure is 1,100-ft tied arch planned for Hudson River crossing.

structure progresses. Fendering and ice-breaking racks will be provided at all piers. The bridge plan contemplates three wide traffic lanes in each direction with a center strip for disabled cars and an emergency walk on each side.

The Grand Island bridges over the Niagara River, which were recently transferred from the Niagara Frontier Authority to the Thruway Authority, are already operating as a part of the Thruway system.

Procedures for Subsurface Explorations

Extensive use is being made of geophysical procedures for subsurface explorations. Now in operation are two of the most modern types of refraction seismographs and one earth electrical resistivity apparatus. The seismographic procedure involves taking time-direction measurements on vibrations set up by small explosions. To date, the seismograph has been used only in determining the elevation of ledge rock, and in practically all instances the information thus obtained has been supplemented by actual drilling operations. This procedure acts as a safeguard against possible misinterpretation of seismic results.

While the basic theories governing seismic exploration are fairly well developed, the application to various field conditions has not been broad enough to assure certain results without the use of some type of factual verification. However, the seismic procedure has been found particularly applicable in extending information obtained from the drilling work. It will also effect major savings in time and money.

The electrical resistivity procedure consists of passing an electrical current through the earth and measuring the voltage drop at specific intervals. From these measurements, it is possible to determine the characteristics of the soil profile. The work in New York State to date has indicated that the accuracy of this method is limited, and considerable preference is being given to seismic equipment. The electrical resistivity procedure, however, has proven useful in determining the location, depth and extent of granular deposits.

It frequently happens in modern highway design that high embankments fall on soils of questionable supporting strength. It should be noted that the depth to which stresses in the soil extend beneath a loaded area is not dependent on the unit load, but on the width of the loaded area.

Earth embankments with base widths of 300 ft are not uncommon in Thruway plans. This means that the soil, for a depth of at least 300 ft, is subject to shearing stresses that may be sufficient to cause failure, and to normal pressures which may be sufficient to cause major consolidation. Therefore it was often found necessary to use special designs, including the construction of extensive berms adjoining the embankment proper to eliminate shearing action in the foundation under the imposed load. Often it is impractical either to reduce or sufficiently accelerate the consolidation of the soil to eliminate undesirable settlement, and estimates must be made of the probable settlement and provision made accordingly at the time of design.

Problem of Excavated Materials

Perhaps the soil problem most often encountered in the present design of the Thruway is the proper utilization of materials obtained from excavations. Part or all of the material excavated within the roadway proper may be unsuitable for the construction of an embankment by normal procedures. Usually the material is undesirable because of its high moisture content. For many of the designs, it is considered best to employ such material in that part of the embankment outside the section immediately supporting the pavement, rather than to dry the soils to a moisture content necessary for proper compaction. Where minor quantities of earth are involved, the most economical procedure is often to waste the unsuitable material.

All new plantings are being designed in relation to the surrounding hills, woods and farm lands. Indigenous trees and shrubs to be used include oak, ash, hickory and walnut, sugar maple, beech, birch, hemlock and pine. Among the sub-trees will be flowering dogwood, hornbeam, shadbush and hawthorn.

Landscaping Used as Screen

New plantings will be concentrated chiefly at major traffic intersections, although some will be used along the roadside to screen objectionable offscapes, and on the mall to reduce headlight glare. Because of the size of a complete cloverleaf intersection (approximately 60 acres) a woods growth is considered the least costly cover.

To blend newly graded surfaces with the adjacent topography, Thruway builders are giving special attention to the modeling of land forms and flattening of cut-and-fill slopes.

Topsoil salvaged during grading operations is being replaced to a depth of 4 in. on drainageways, the mall, and all ground surfaces disturbed by grading operations except the shoulders along the outer lane. These shoulders are being mechanically stabilized without the addition of topsoil.

Fine trees, groves, and other landscape features are carefully preserved wherever possible, in conformity with general state highway policies. Topsoil is laboratory tested to determine the kinds and amounts of fertilizers needed to support plant growth, and appropriate grasses and legumes are chosen for each local condition.

The need for this superhighway is unquestioned. In general, any opposition to it has been in particular, not in principle. It will bring benefits to commerce, industry, agriculture and the motoring public. A vital transportation artery, it will serve the state and the nation in peace and in war. To these ends, the Thruway is being advanced with all possible speed, although progress will be slowed by the present shortage of steel.

California engineers guide state legislation

ANTHONY J. KENNEDY, Attorney-at-Law, Sacramento, Calif.

THE PURPOSES of the California Legislative Council of Professional Engineers are to develop professional engineering and land surveying for the protection of public health and safety, to coordinate the legislative activities of the member organizations, and to make members of the profession aware of their opportunities and responsibilities for good state government.

THE COUNCIL was organized in 1948 to take the place of a similar group that had represented the civil, structural, and county engineers. At present 17 organizations are included in the Council—11 California local sections of Founder Societies plus 6 other organizations of engineers and land surveyors.

FOR TWENTY YEARS the writer has been associated with engineers—civil engineers in particular. He is now the legislative counsel of the California Council of Professional Engineers. Beginning in 1931 with his appointment as legal aide to the newly created Board of Registration for Civil Engineers in California, he has worked almost continuously in the interest of the profession. This article is abstracted from his recent address before ASCE's Los Angeles Section.

BETWEEN the workings of the engineering and the legislative mind there is a wide gulf. Engineers seek to determine facts and to translate them into concrete achievement. They are reluctant to assume leadership in legislation, where policy is formulated on the basis of a wide variety of considerations which cannot be evaluated precisely.

Yet the engineering profession, through inventions and new processes of the machine age, is the catalytic agent responsible for a vast amount of legislation. If this statement seems astonishing, it can easily be substantiated by a glance at the mass of bills before the present session of the California Legislature. Twenty or thirty deal with the vital subject of air pollution. A series of bills would authorize the State Water Resources Board to investigate the beneficial uses of water in the state, and one bill provides for a bond issue of $400,000,000 to develop projects for the conservation of water and the production of power. Some twenty bills are concerned with the control of water pollution. Numerous other bills pertaining to flood control, zoning, irrigation, reclamation, highways, building codes, and school construction could be cited to emphasize the fact that engineers must assume a full share of responsibility for today's social and economic life—and for the legislation that regulates it.

Of all professions and groups, only engineers have the complete reservoir of knowledge, ability and experience for solving the problems created through engineering progress. This reservoir often remains untapped because engineers, either from modesty or from a false sense of ethics, sit back waiting for their services to be requisitioned. This hands-off attitude may also be based on a fear that legislative activity will be interpreted as political pressure, but in any event it is wrong since it weakens the forces of good government.

Legislators Want Guidance

Let us look at the problem from the legislator's point of view. In the 1951 session of the California Legislature, 5,167 bills have been introduced. Judging from past sessions, some 1,600 of these will be considered of sufficient importance to pass both houses, receive the Governor's signature and become law. Committees will divide and classify this legislation and make recommendations, but in the final analysis it will be each individual legislator's obligation to vote "aye" or "nay" on every bill that reaches the floor.

The legislator obviously cannot do a research job on every bill. He needs intelligent guidance from responsible, informed sources. When his sources of information on a bill are reliable, his vote is right and the cause of good government is served. When in doubt, the legislator will turn to those he knows and trusts. If he has no means of contact with the engineering profession, its knowledge and experience will be inaccessible to him. In the interest of good government, the profession should sift out of the mass of legislation those bills on which it can give expert advice, and transmit this advice to the legislators, so that they will be able to draw upon it in deciding how to vote intelligently.

In the matter of civilian defense, for instance, it is not sufficient that individual engineers be actively engaged in studying its engineering aspects. Somewhere, in the maze of societies and associations, there should be committees through which the services of the profession can be made available to the public agencies most in need of them.

The California Legislative Council of Professional Engineers is making a determined effort to fill needs such as this. For example, various members of the Council worked this year for the first time with legislative committees—particularly with the State Senate committee studying school construction, the Assembly committee working on overlapping jurisdictions in building codes, and the Assembly committee on conservation and planning. In each case, the members of the legislative committee welcomed the constructive help the engineers could give.

If the influence of the profession is to be made effective for good government, unified action is a necessity. Such action can only be obtained through a representative group which can direct the energies of its members. The Legislative Council is achieving success in assisting California engineers to make their voices heard in government at the state level, and similar agencies may be the answer to this problem in other states.

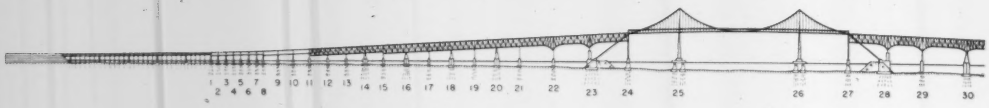


FIG. 1. ELEVATION of Chesapeake Bay Bridge shows variety of structures used on 4.3-mile crossing. Suspension span measures 1,600 ft center to center of towers. Structure is estimated to cost more than $42,000,000. J. E. Greiner Co., Baltimore, Md., designed the bridge.

Ingenuity and heavy equipment combine to

AS IF in resentment at man's attempts to bridge the channels of Chesapeake Bay, nature has lashed out with uncommon fury. Treacherous tides, high winds, and bad weather, topped by the hurricane of last November, have combined to bedevil the builders of what even under ordinary conditions would be a difficult job. The Chesapeake Bay Bridge, stretching 4.3 miles, involves some of the heaviest construction attempted in this country in many years. The construction plant used by the six contractors on the job is estimated to have totaled, at one particularly active period, almost $5,000,000. At times, it has seemed possible to walk from one shore to the other over the hundreds of pieces of heavy floating equipment.

When completed, this unusually long structure will form an important link in the chain of superhighways proposed or now being built which will join New England with Florida. In the course of its length, the Chesapeake Bay Bridge embodies a variety of types of structural spans. Included in its design are decked girders, decked trusses, decked cantilevers, through cantilevers, and a suspended span 1,600 ft long from center to center. (Figs. 1, 2, and 4). At present the cost of the structure is estimated at between 42 and 44 million dollars. The project will be financed by a 20-year bond issue. However it is expected that tolls will pay back the cost of the structure before that time. The bridge is expected to open some time in mid 1952.

This bridge is interesting not only because of the multiplicity of structural designs in the superstructure, but also because of its unusual piers. Of the bay piers, 27 are of conventional design and were constructed in conventional cofferdams. After these steel sheetpile cofferdams were driven, braced, tremie sealed, and dewatered, the bridge piers were poured in the dry. These piers, 10 on the west end of the bridge and 17 on the east end, all rest on steel H-piles driven into the bay bottom.

Of greater interest to engineers, however, are the 24 Potomac-type piers (Fig. 3), 12 on each side of the suspension span. These piers, first used on the Potomac River Bridge, whence their name, require no cofferdam but are poured in permanent steel forms commonly called cans. This method was developed by the engineers, J. E. Greiner Co. of Baltimore, and used by two of the contractors, Merritt-Chapman & Scott and J. Rich Steers.

The procedure is as follows. The pier site is dredged to natural sand. Wooden piles are driven into the bed of the bay, and a wooden mat is sunk in exact position at the site of the pier and secured to the timber piles by divers. Guides erected at the edges of this mat are used to

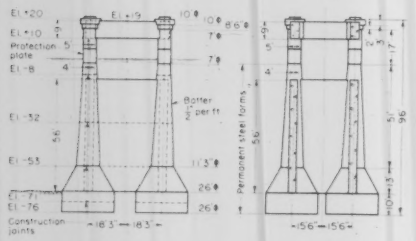


FIG. 3. POTOMAC-TYPE PIER requires no cofferdam for erection. Permanent steel form is built in nearby shipyard, with reinforcing bars in place before sinking. Form is filled with tremie concrete to within 8 ft of top. Both four-bell piers and two-bell piers were used.

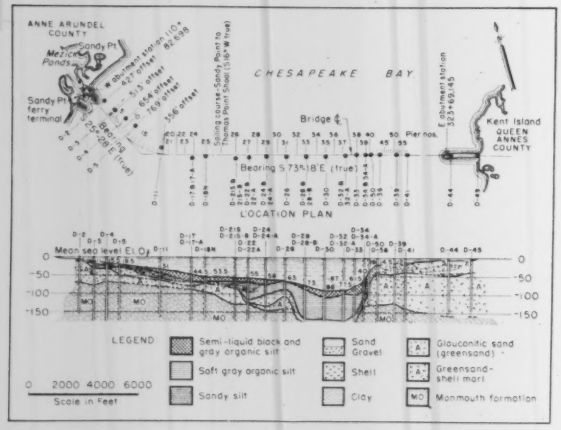


FIG. 4. PROFILE shows depth of sand strata along center line of bridge. Suspended span runs between Piers 25 and 26. Through cantilever runs from Pier 36 to Pier 39.

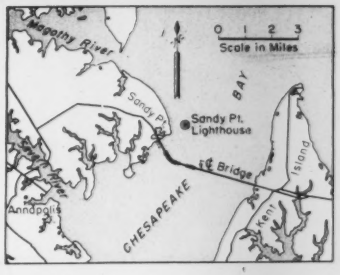


FIG. 2. CHESAPEAKE BAY BRIDGE, which connects Sandy Point with Kent Island, Maryland, will be link in New England-to-Florida expressway.

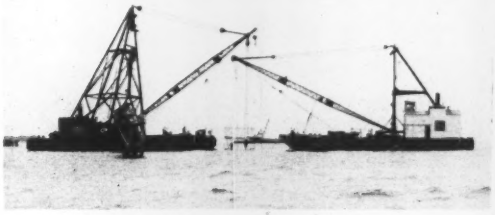
build 4.3-mile Chesapeake Bay Bridge

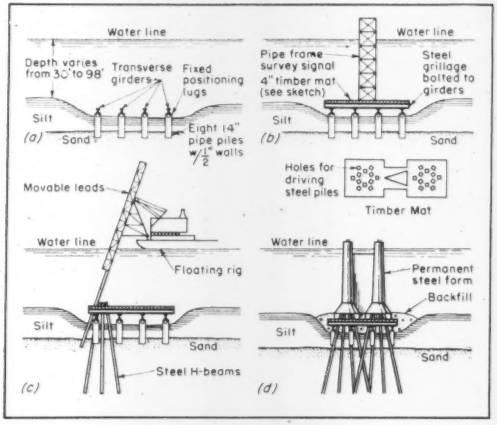
locate it during driving. These timber mats have holes cut through them at various predetermined locations, through which the contractor must drive the steel H-piles at various batters in various directions. As the allowable error on the driving of these piles was very small, the contractors erecting the piers tried in vain for some time to find the best method to position and drive the steel piles to the required accuracy. This difficulty was overcome when Robert Trimble of the Frederick Snare Corp. suggested the use of a gyrocompass on the floating pile driver. This method worked out very well and was used by all contractors on the job.

When the permanent steel piles, both batter and plumb, had been driven, the permanent steel form for the pier was lowered over the piles and set on a wooden platform. This form looks somewhat like milk cans with long necks which have a circular section, bell-shaped bottom and tapering stack. The dimensions of the forms vary according to the depth of the piers. When the cans are in position on the timber mat, a tremie seal is poured. Once the seal has set, the load of the pier is taken by the permanent steel piles. The pier is then poured with tremies to within 8 ft of the tops of the cans, and the remaining height of the pier is poured in the dry.

The cans were fabricated at the Baltimore Shipyards of the Bethlehem Steel Co. They were designed both in pairs, for some piers, and in groups of four, for other piers. A steel diaphragm, running from about 10 ft from the bottom of the form to within 10 ft of the water line, was welded between all cans.

The Frederick Snare Corp. adopted a slight variation of the





UNUSUALLY HEAVY RIGS (upper left) lower timber mat a pier site prior to sinking of steel form for Potomac-type pier. Pipe frame seen extending above water is fixed to middle of mat and is used as survey signal in positioning it. Floating concreting plant (upper right) has two 2-cu yd batchers. Specially designed rig (lower right) drives steel H-piles through timber mat to proper batter. Rig mounts gyrocompass so that piles can be accurately located.

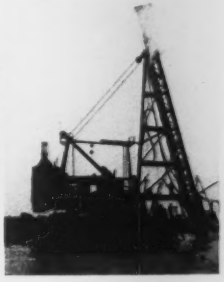
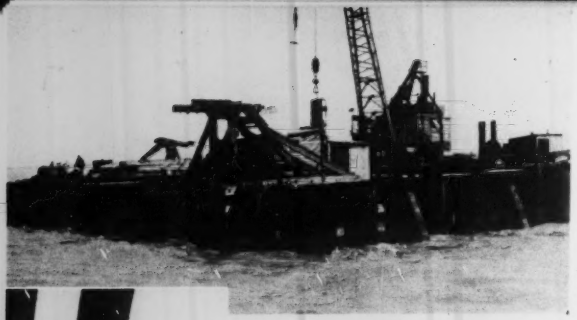


FIG. 5. METHOD of erecting Potomac-type piers used by Frederick Snare Corp. is shown at left. (a) Pipe-piles are driven in dredged pier site, and steel sections are attached. (b) Steel grillage with 4-in. timber mat attached is sunk and bolted in position on transverse girders. (c) Steel H-Beams are driven through precut holes in timber mat by single-acting McKiernan-Terry S10 air hammer. (d) Forms are lowered onto timber mat and tremie seal is poured.



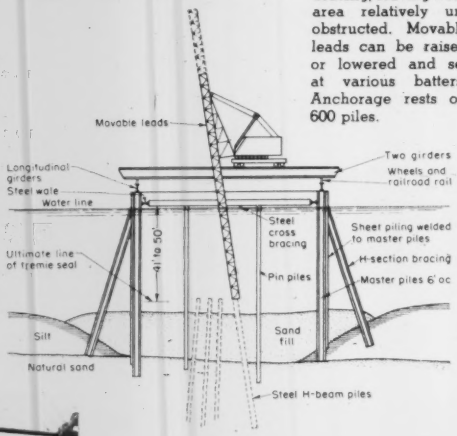


FIG. 6. (below) Unusual design of cofferdam for erection of anchorages permits easy access to all parts of site. Heavy master piles serve to minimize cross bracing, leaving work area relatively unobstructed. Movable leads can be raised or lowered and set at various batters. Anchorage rests on 600 piles.

above method. Instead of timber piles, 14-in. pipe piles were driven into the dredged pier site (Fig. 5). This reduced the number of piles needed under the timber mat to eight for the average two-column pier. These pipe piles were arranged in two rows, and steel girders were fastened to the top of each row by male connections which secured the girders to the piles. A steel grillage, with a double layer of 4-in. timber mat, similar to the timber mat suggested by the engineer, was then sunk, positioned and bolted to the steel girders. Here, instead of guides fastened to the platform, a steel pipe tower was erected in the middle of the mat as a survey signal for locating the mat precisely on the bottom.

Three Advantages of Method

The engineers for the Snare Corp. believe this method to be advantageous because (1) it minimizes the underwater work; (2) the mat sinks of its own weight; and (3) the eight pipe piles offer less interference with the driving of the permanent steel batter piles.

This Potomac-type pier proved difficult to build, especially because much of the preliminary work on the

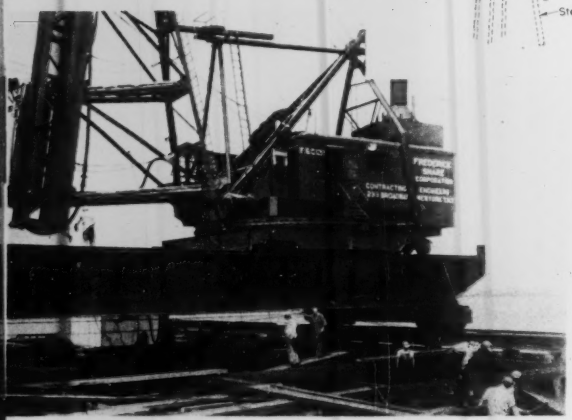
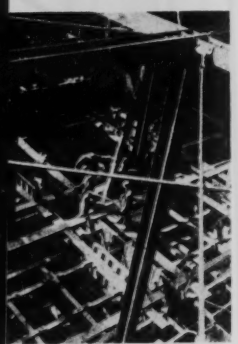
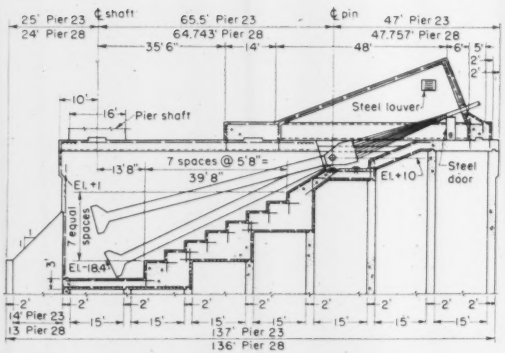


FIG. 7. (below) Anchorages for suspension span serve also as pedestals for Piers 23 and 28. Note that stepped blocks of structure are hollow.



MASTER PILES for cofferdam for Pier 28 are driven around timber frame (top of page). Rig in background is driving steel sheeting between master piles. Close-up of master pile (next below) shows detail of welded sheetpiling. Corner pile in background weighs 30 tons. Driving rig mounted on cofferdam walls (above, left) has three motions, transverse, longitudinal and rotational. Leads, at left, may be lowered and set at any batter for driving anchorage's 600 piles, most of them battered. After tremie seal is poured and cofferdam is unwatered, piles are cut off (above, right). Pin piles may be seen running up to top of cofferdam to support bracing. Workmen place concrete in walls of Pier 23 (left). Note open working area made possible by this type of cofferdam.



piers is subaqueous. The divers are hampered considerably by the unusually strong tides and currents at the construction site. Currents strong enough to drive the divers out of the water are set up when storage is released from a hydro plant located on the Susquehanna River.

The four tower piers for the suspension span also are of the Potomac type and were built by the first method outlined above.

The two 149 x 78-ft cofferdams for the construction of the anchorages (Fig. 7) were designed to facilitate the driving of the 600 steel H-piles which support each anchorage. The master-pile type of cofferdam used in this project is one not frequently seen (Fig. 6). The method involves driving heavy steel master piles (36 WF 170 in this case) on 6-ft centers around the perimeter of the cofferdam site. Half sections of interlocking sheetpiling are welded to the outside flanges of these heavy piles. The master piles are braced by one ring of steel wales 44 to 50 ft above the top of the tremie seal. These steel wales are initially carried on a timber frame driven before the master piles.

Each master pile is connected with the adjoining one by three sections of sheetpile, which are driven to lock with the half sections already welded to the masters, thus requiring 76 closures in each cofferdam. The accuracy of the driving therefore must be high. After the sheetpiles are driven, two heavy girders are fastened to the top of the master piles parallel to the long axis of the cofferdam. On each of these two girders a railroad rail is fixed. A heavy framework of girders is mounted across these two girders and runs on the rails. On top of the girders there is a revolving driving rig which can move across the cofferdam on the transverse girders. The rig mounts movable leads which not only can be set at any batter, but can be raised and lowered to allow for the varying depths of water.

Pin Piles Support Cross Bracing

As the many piles for the anchorage were driven, the timber frame supporting the wales is removed and replaced by long pin piles which extend up to the top of the cofferdam and support the steel cross-bracing. After all the piles for the east anchorage (Pier 28) were driven, the pile-driving leads, mounted on the walls of the cofferdam, was used in the concreting operations.

One of the disasters of the hurricane of last November was the disappearance of a barge load of master piles, which included one of the 36 WF 300 corner piles. The contractor enlisted the aid of a plane equipped with a magnetometer, since this lost barge might easily be a navigation hazard to the heavy ocean-going traffic in the Bay. The plane flew a mission over the area and was able to get an indication about 7 miles from the bridge site. The contractor was given coordinates of the spot and set out buoys. The area was dragged and all the piles were recovered. Some had sunk 10 ft in the mud. But the barge has never been found.

Because of the high elevation of some of the trusses, the contractor for the superstructure, Bethlehem Steel, has adopted a unique erection scheme. The trusses for the span adjoining the suspension anchorages were erected first, using a floating crane mounted on a high tower. After this span was up, two erection cranes were mounted on the completed span and are being used to assemble the remaining trusses, each on falsework alongside. The trusses are then floated off the falsework on barges and the barges are floated into position and slowly sunk to lower the truss onto the bearing plates. When the barges have been towed away, the next truss is assembled on the falsework, and is similarly placed.

The engineer for the project, which is being built for the Maryland State Roads Commission, is the J. E. Greiner Co. of Baltimore, Md., whose project engineer is R. A. Gilmore, M. ASCE, and whose resident engineer is Bruce Herman, Assoc. M. ASCE.

The construction of the project was let in six separate contracts to Booth & Flinn, Merritt-Chapman & Scott, Frederick Snare Corp., J. Rich Steers, Baltimore Contractors, and The Bethlehem Steel Co. The latter is building the superstructure. E. C. Lampman is superintendent for Frederick Snare Corp. on the substructure work.

David Bonner, M. ASCE, Vice-President of the Frederick Snare Corp., assisted in the preparation of this article by giving information to Robert K. Lockwood, Jun. M. ASCE, Associate Editor, CIVIL ENGINEERING.

ERECTING CRANES on outermost decked truss assemble a second truss on falsework, from which barges will pick it up and float it into position. Barges will then be towed back for use in erecting other trusses.

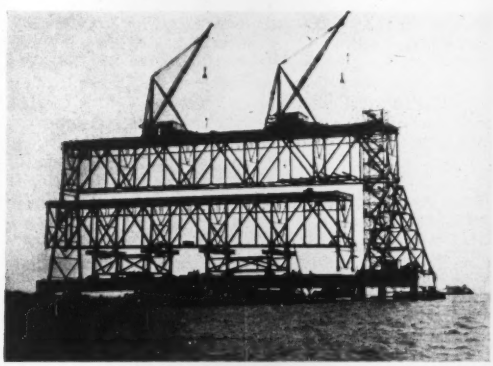
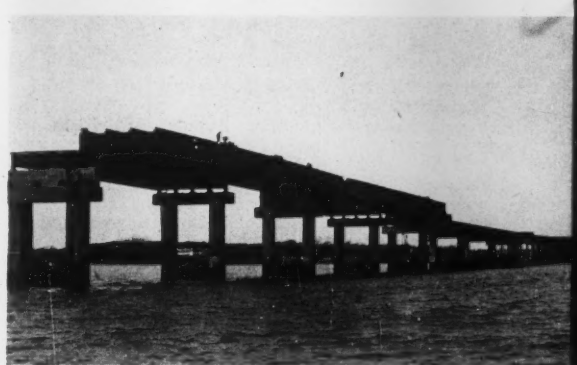


PLATE GIRDERS are readied for erection in west end of Chesapeake Bay Bridge. Concrete piers in foreground were erected in conventional cofferdams. Piers further out in bay are Potomac type, requiring no cofferdams.



Movements of Sather Tower measured by transit and Nilvar wires

NED P. CLYDE and MILOS POLIVKA

Respectively, Consulting Engineer, Clyde and Associates, Consulting Civil Engineers, Oakland, Calif. and Assistant Professor of Civil Engineering, University of California, Berkeley, Calif.

AS PART of an investigation to determine the cause of cracking in the granite face of the Sather Tower at the University of California, Berkeley, procedures were developed for measuring the lateral and vertical movements of the tower due to temperature changes. The tower, (*a*) on facing page, is 288 ft high, and has a steel frame braced in alternate stories and embedded in concrete 12 in. thick. The 6-in.-thick granite facing has no expansion joints and is anchored rigidly into the concrete walls. A more detailed description of the structure and its history were given by Walter T. Steilberg in the February 1950 issue of the *California Monthly* (Alumni Publication, University of California).

The original plan was to use a direction theodolite to determine the horizontal displacement of the top of the tower with respect to the base. However, to obtain the necessary number of observations would have required the use of four theodolites and numerous computations to determine the lateral movements, and for the small vertical movement, the use of the theodolite was found to be impractical. Various other schemes were considered before the one here described was adopted.

To determine the lateral movement of the tower, one target, (*c*) on facing page, was placed at approximately the center of each of the tower's four faces, on the top balcony 228 ft above the ground. Each target was fastened to a board, which in turn was fastened to the tower face. Precautions were taken to prevent movement of the boards, which were rigidly bolted to the structure and were at all times protected from the sun. The boards had been seasoned for over a year, grooved to prevent warping, covered with fiberboard, and weather sealed.

Each target was read by a transit, (*d*) and (*e*), placed directly under it at the base of the tower. The transit was fastened on a trivet, a metal baseplate with three short legs. The sunshade of the transit was fitted with a brass prism holder and prisms. The prisms deflected the line of sight by 90 deg and permitted observations on the scales, (*c*), with the telescope in a horizontal position. The target was so oriented that observations of lateral movement of the center of the face of the tower could be made in both north-south and east-west directions. Lateral movement of the tower was determined by observing the position of the crosshairs of the transit on the two mutually perpendicular horizontal scales of the target.

Vertical movement of the tower was determined by observing markers attached to Nilvar wires (*b*) suspended from the parapet wall of the tower 224 ft above ground. One wire was suspended at the center of each face of the tower, at approximately the same location as that used for measuring the lateral movement. A 12-lb weight was fastened to the bottom of each wire, and readings were obtained by observing the relative position of the marker on the wire by means of a mirror-type scale rigidly fastened on a frame at the base of the tower (*f*).

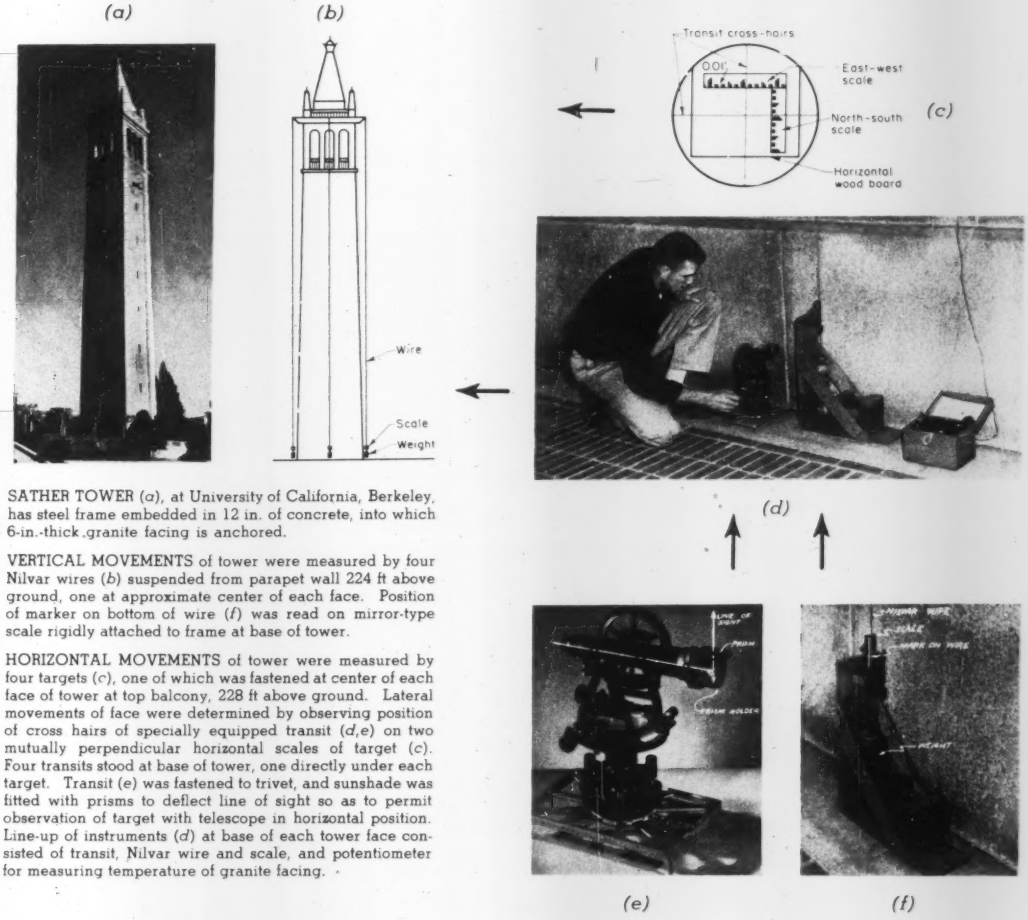
Air temperatures were measured by thermometers located near the transits, and the temperature of the granite near the base was determined by thermocouples held against the surface of the granite.

Typical measurements of the lateral movement of the center of each tower face at the top balcony between 7 a.m. and 5 p.m. are shown on the squares at the bottom of the facing page. The squares represent the tower cross-section (not to scale), and the magnitude and direction of the lateral movement of the top of the tower are indicated at the center of each face. Air temperatures, in degrees Fahrenheit, are shown in parenthesis. The arrows at the centers of the squares represent the resulting direction of the lateral movement. It should be noted that as the faces of the tower became exposed to the sun, the lateral movement was in a direction away from the sun. There was a lag between the movement of the tower and that of the sun, explained by the fact that when another face of the tower became exposed to the sun, the previously exposed face was still warm, so that the tower was prevented from moving in a direction directly opposite to that of the sun.

The vertical movement of the tower, measured by the Nilvar wires, was very small, the maximum observed value being 0.12 in. at 1 p.m. at an air temperature of 85 deg F. Since the temperatures of the interior of the tower and of the steel frame were almost constant throughout the day, large movements of the exterior facing were prevented, and this restraint probably developed considerable compressive stress in the facing.

This investigation to determine the cause of the cracking of the granite facing is under the direction of Walter T. Steilberg, consulting architect, Berkeley, Calif. The measurements described were taken by the authors with the assistance of George Wendell and the equipment for the investigation was built by E. L. Whittier, all of the University of California at Berkeley.

NOTEBOOK

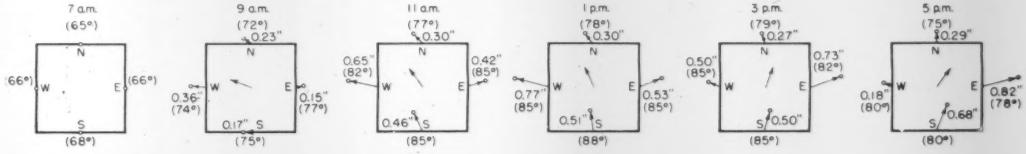


SATHER TOWER (*a*), at University of California, Berkeley, has steel frame embedded in 12 in. of concrete, into which 6-in.-thick granite facing is anchored.

VERTICAL MOVEMENTS of tower were measured by four Nilvar wires (*b*) suspended from parapet wall 224 ft above ground, one at approximate center of each face. Position of marker on bottom of wire (*f*) was read on mirror-type scale rigidly attached to frame at base of tower.

HORIZONTAL MOVEMENTS of tower were measured by four targets (*c*), one of which was fastened at center of each face of tower at top balcony, 228 ft above ground. Lateral movements of face were determined by observing position of cross hairs of specially equipped transit (*d,e*) on two mutually perpendicular horizontal scales of target (*c*). Four transits stood at base of tower, one directly under each target. Transit (*e*) was fastened to trivet, and sunshade was fitted with prisms to deflect line of sight so as to permit observation of target with telescope in horizontal position. Line-up of instruments (*d*) at base of each tower face consisted of transit, Nilvar wire and scale, and potentiometer for measuring temperature of granite facing.

RESULTS OF MEASUREMENTS appear on squares. Lateral movements at top balcony are given at center of each face in inches, with arrows to indicate direction. Air temperatures, in degrees Fahrenheit, are shown in parenthesis for each face. Arrows in centers of squares show resulting direction of lateral movement. Initial readings were taken at 7:00 a.m. (first square). Vertical movement of tower, measured by Nilvar wires, was found to be extremely small; maximum observed value was 0.12 in. at 1 p.m.



THE READERS WRITE

Additional Factors Influence Economy of Flood Control Dams

TO THE EDITOR: Considerable importance attaches to the choice of the type of dam for a given site and the choice of a site to meet the needs of a particular situation. In this connection I read with interest Dr. J. J. Polivka's letter in the November 1950 issue ("Large Savings Estimated from Constant-Angle Dam Design, Nov. 1950, p. 45). The discussion by Horace A. Johnson (Feb. 1951, p. 46) was entitled "Economy of Constant-Angle Arch Dam Depends on Site Conditions." I agree with this statement but must disagree with Mr. Johnson's view that "The best measure of the reasonableness of the cost of a dam is the cost per acre-foot of storage, except for pure diversion dams." An exception should also be made for flood control dams, particularly as mention was made of the Pacoima Dam of the Los Angeles County Flood Control District in comparison with a structure for another purpose.

The Pacoima site is one of the most ideal V-shapes that I have seen and, in my opinion, choice of the constant-angle type resulted in greater economy than any other type.

Much has been said in the past on the high costs of flood control dams in Los Angeles County, expressed in acre-feet of storage capacities. Such unit costs are unrealistic for the following reasons.

A flood control dam is primarily a single-purpose structure, its basic function being the protection of lives and properties. Such dams are operated for stream regulation, to reduce flood peaks to amounts that can be safely handled by the stream channel downstream. Incidental holdover conservation results from increased percolation into groundwater reservoirs downstream from the flood control reservoirs. Those reservoirs frequently have storage capacities many times greater than the storage capacities above the flood control dams. It is not unusual for a flood control reservoir to store, temporarily, and release in one year, $3\frac{1}{2}$ times (or even more) the nominal capacity of the flood control reservoir. If we measure the justification in terms of storage capacities, consideration should be given to the amounts conserved underground as compared with quantities that would otherwise escape unused to the ocean.

Another function of flood control reservoirs is control of debris from denuded watersheds. The cost of Pacoima Dam is given as $438 per acre-ft. Translated into costs per cubic yard of debris stored, the cost is 27 cents—an amount much less than would be required to remove this debris from the streets.

COURTLANDT EATON, M. ASCE
Consulting Engineer

Golden, Colo.

Statement in EJC Water Policy Panel Report Disavowed

The following two letters, written to Gail A. Hathaway, President of ASCE, clarify the responsibility for the statement in the EJC Water Policy Panel Report that engineers with records of government service should be debarred from serving on Boards of Review.

DEAR MR. HATHAWAY:

During recent trips to Washington, D. C., I have heard much criticism, in various government offices, of certain statements in the report on water policy prepared under the auspices of the Water Policy Panel of the Engineers Joint Council. Specifically, I found that offense had been caused by a statement prepared by the Committee on General Economic Principles, appearing on page 23 of Appendix IX. This statement reads as follows:

"The membership of such a board should consist of thoroughly qualified personnel, provided with adequate staff. No member should be a person assigned from, or within the preceding 5 years an employee of, any Federal Agency or a person who has for more than 5 years been an employee of any Federal Agency. A reasonable proportion of the board's membership should be selected from a list nominated by Engineers Joint Council or some like qualified body representative of the engineering profession."

I was amazed to learn from several widely separated sources that Mr. Harza and I were receiving credit for the initiation and support of this statement. Actually, we had nothing to do with it. Neither of us signed this statement, nor had we any connection with the committee that formulated it. Furthermore, Mr. Harza and I are in complete disagreement with the statement. It is a matter of the utmost regret that I must disagree so completely with our friends on this committee on this point.

In my opinion, this statement has no place in a report dealing only with the broadest aspects of water control policy. The composition of boards of review does not warrant such exact definition at this stage. Furthermore, the statement is a downright insult to any responsible engineer who now works—or has ever worked—for the government. It says in effect that one loses all objectivity after spending five years in government service. It is difficult to believe that the authors so intended it; I much prefer to believe that the whole thing was not thought through properly.

Sincerely,

CALVIN V. DAVIS, M. ASCE
Harza Engineering Co.

Chicago, Ill.
February 24, 1951

* * * *

DEAR MR. HATHAWAY:

With regard to the letter from Calvin V. Davis dated February 24, which you have forwarded for comment, I am offering the following:

1. A check of the Committee indicates that neither Mr. Davis nor Mr. Harza served on Task Force Committee No. 9.
2. Mr. Davis' letter refers to the item in Appendix 9 as prepared by Task Force Committee No. 9.
3. Mr. Davis served on Task Force Committee No. 2—Flood Control, which Committee, as shown in Appendix 2, offered the following statement: "All Flood control projects should be reviewed and approved by a competent board of review independent of the Federal agency proposing the project."
4. The controlling statement with respect to this matter is that of the Coordinating Committee appearing on pages 20 and 21 of the "Statement of the Coordinating Committee." The pertinent phrasing is as follows: "To accomplish this purpose (i.e., impartial analysis) to the maximum advantage to the citizens of this country, such a body would have to be drawn largely from outside Governmental personnel, although obviously participation by the Federal Agencies in the deliberations is a prime requisite to intelligent diagnosis and decision."

Very truly yours,

ABEL WOLMAN, M. ASCE
Chairman, Coordinating Committee, Engineers Joint Council

Baltimore, Md.
March 8, 1951

AMERICAN SOCIETY OF CIVIL ENGINEERS

LOUISVILLE CONVENTION

BROWN HOTEL, LOUISVILLE, KY., JUNE 13–15, 1951

Registration: Lobby of Brown Hotel, opens 2:00 p.m., Tuesday, June 12; each convention day 9:00 a.m. to 5:00 p.m. Registration fee (except ladies and students) $2.00. Student members pay half price for all functions.

Author's Breakfasts

PARLORS A, B, AND C
BROWN HOTEL

Wednesday, June 13, 8:15 a.m.
Thursday, June 14, 8:15 a.m.
Friday, June 15, 8:15 a.m.

Briefing sessions for all speakers, discussers and program officials by invitation. *Presiding:* SAMUEL M. BAILEY, Chairman of Technical Program.

Membership Luncheon—Wednesday, June 13

12:30 P.M. CRYSTAL BALLROOM
BROWN HOTEL

Presiding: CRAIG P. HAZELET, President, Kentucky Section ASCE.
Chairman: CHARLES W. LOVELL, Louisville Convention.
Vice President: DANIEL V. TERRELL, American Society of Civil Engineers
The principal speaker will be

MAJ. GEN. LEWIS A. PICK, M. ASCE, Chief of Engineers, USA

All members, their ladies, guests and friends of ASCE are cordially invited to attend this luncheon. Price $3.00 per plate.

Men's Smoker

Sponsored by District 9 Council
Wednesday, June 13
8:00 P.M. CRYSTAL BALLROOM
BROWN HOTEL

This will be a get-together for the men with plenty of beer and refreshments and a good program of entertainment including an orchestra and floor show. Sandwiches and coffee will be served later in the evening.

Price, $2.00 per ticket.

Ladies' Entertainment

Wednesday, June 13

4:00 p. m. Ladies Tea

At the home of Mr. and Mrs. George R. Bickel on Lime Kiln Road. Transportation will leave Brown Hotel at 3:15 p. m.

8:30 P.M. ENTERTAINMENT
ROOF GARDEN BROWN HOTEL

Featured for the evening will be a most interesting color movie entitled "Your Kentucky" with an accompanying speaker, presented through the courtesy of the Kentucky Department of Highways. This will be followed by a ballad singer. Sandwiches and coffee will be served after the program. No charge.

Wed. Morning, June 13

Welcome to Louisville and ASCE Business Meeting

10:00 A.M. CRYSTAL BALLROOM
BROWN HOTEL

Presiding: GAIL A. HATHAWAY, President, American Society of Civil Engineers

10:00 **Welcome to Louisville**

By the Kentucky Section:

CRAIG P. HAZELET, President, Kentucky Section

By the City of Louisville:

DANN C. BYCK, President, Board of Aldermen

Response

GAIL A. HATHAWAY, President, American Society of Civil Engineers

10:30 **Address: Engineering Education in the National Emergency**

HENRY T. HEALD, M. ASCE, President, Illinois Institute of Technology, Chicago, Ill.

11:30 **General Business Session of ASCE**

12:00 **Adjournment for Membership Luncheon**

Wed. Afternoon, June 13

Division Sessions

Hydraulics Division

2:00 P.M. SOUTH ROOM

Presiding: George R. Schneider, Assoc. M. ASCE, Chairman, Executive Committee, Hydraulics Division

2:00 **Experimental Study of Flow of Water in Pipes of Annular Cross Section**

W. M. OWEN, Research Assistant Professor of Theoretical and Applied Mechanics, University of Illinois, Urbana, Ill.

Discussion

2:45 **Experimental Investigation of Fire Monitors and Nozzles**

J. W. HOWE, M. ASCE; Professor and Head, Department of Mechanics and Hydraulics, University of Iowa, Iowa City

3:30 **Problems in Design and Operation of Storm Water Pumping Stations in Ohio Valley**

R. L. IRWIN, Assoc. M. ASCE; Hydraulic Engineer, Ohio River Division, Corps of Engineers, Cincinnatti, Ohio.

Sanitary Engineernig Division

2:00 P.M. ROOF GARDEN

Presiding: B. A. Poole, M. ASCE, Member, Executive Committee, Sanitary Engineering Division

2:00 **Pollution Control in Ohio River Valley**

EDWARD J. CLEARY, M. ASCE; Executive Director and Chief Engineer, Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio.

2:45 **New Sewage Treatment Plants in Kentucky**

J. STEPHEN WATKINS, M. ASCE; Consulting Engineer, Lexington, Ky.

3:30 Sewage Collection and Treatment for Louisville

L. S. VANCE, Technical Adviser, Louisville and Jefferson Co. Metropolitan Sewer Dist., Louisville, Ky.

Surveying and Mapping Division

2:00 P.M. **LOUIS XVI ROOM**

Presiding: H. B. Aikin, Assoc. M. ASCE, Member, Executive Committee, Surveying and Mapping Division

2:00 Procedures for Making Highway Soil Surveys

K. B. WOODS, M. ASCE; Associate Director of Joint Highway Research Project and Professor of Highway Engineering, Purdue University, Lafayette, Ind.

Discussion

L. E. GREGG, Assoc. M. ASCE; Assistant Director of Research, Department of Highways, Commonwealth of Kentucky, Frankfort, Ky.

2:45 Topographic Mapping Program for Kentucky

PHIL M. MILES, Chief, Maps and Minerals Division, Agricultural and Industrial Development Board, Commonwealth of Kentucky, Frankfort, Ky.

Discussion

WILLIAM S. MASSA, Maps and Surveys Branch, TVA, Chattanooga, Tenn.

3:30 Standards of Accuracy for Highway Surveys

J. C. CARPENTER, M. ASCE; Supervising Highway Transport Research Engineer, Bureau of Public Roads, Washington, D.C.

Discussion

J. F. STIGERS, Assistant State Highway Engineer, Department of Highways, Commonwealth of Kentucky, Frankfort, Ky.

Thursday Morning, June 14

Construction and Structural Divisions, Joint Session

9:30 A.M. **ROOF GARDEN**

Presiding: Elmer K. Timby, M. ASCE, Chairman, Executive Committee, Construction Division

9:30 Erection of Mississippi River Bridge at East St. Louis, Ill.

E. L. DURKEE, M. ASCE, Engineer of Erection; and R. C. FIEBRANTZ, Engineer, Bethlehem Steel Co., Bethlehem, Pa.

10:10 Stress Measurements on Mississippi River Bridge at East St. Louis

L. T. WYLY, M. ASCE, Research Professor of Structural Engineering; M. B. LAGAARD, M. ASCE; E. LARSON; K. H. LENZEN, Jun. M. ASCE, Structural Engineer; J. B. MCCAMMON; Purdue University, Lafayette, Ind.

10:50 Design Problems, East St. Louis Veterans Memorial Bridge

A. L. R. SANDERS, M. ASCE; Partner, Hazelet and Erdal, Chicago, Ill.

Highway Division

9:30 A.M. **LOUIS XVI ROOM**

Presiding: Ben H. Petty, M. ASCE, Chairman, Executive Committee, Highway Division

9:30 Planning and Designing the New System of Expressways for the City of Louisville

CHARLES E. DE LEUW, M. ASCE; De Leuw, Cather and Co., Chicago, Ill.

10:00 Obtaining Maximum Utility from Existing Street Systems

GEORGE W. BARTON, M. ASCE; Engineering Director, Associated Consultants, Evanston, Ill.

10:30 An Analysis of Corrective Action for Highway Landslides

R. F. BAKER, Assoc. M. ASCE; Engineer of Soil Mechanics, West Virginia State Roads Commission, Charleston, W. Va.

11:00 Joint Highway-Railway Military Planning

JOHN W. WHEELER, M. ASCE; Executive Assistant, Burlington Lines, Chicago, Ill.

Hydraulics Division

9:30 A.M. **SOUTH ROOM**

Presiding: Dr. George H. Hickox, M. ASCE, Member, Executive Committee, Hydraulics Division

9:30 Groundwater Problems in the Louisville Area

MATTHEW I. RORABAUGH, JUN., M. ASCE; District Engineer, Groundwater Branch, U. S. Geological Survey, Louisville, Ky.

Discussion

WILLIAM F. GUYTON, Assoc. M. ASCE; WALTER N. WHITE and WILLIAM F. GUYTON, Consulting Groundwater Hydrologists, Silver Spring, Md.

PRESTON MCGRAIN, Assistant State Geologist, Kentucky Geological Survey

11:00 Estimation of Flood Probabilities

LEO R. BEARD, JUN., M. ASCE; Corps of Engineers, Department of the Army, Washington, D.C.

Rotary Luncheon

Thursday, June 14

12:15 P.M. **CRYSTAL BALLROOM BROWN HOTEL**

All ASCE Rotary members and guests are cordially invited to attend this regular luncheon meeting of the Louisville Rotary. The principal address will be given by GAIL A. HATHAWAY, President ASCE, who will speak on

An Engineer's Impression of Present-Day India

His trip to India was made as Chairman of U. S. Delegation to International Engineering Conferences in India.

Thursday Afternoon

City Planning Division

2:00 P.M. **LOUIS XVI ROOM**

Presiding: Harry W. Alexander, M. ASCE, Member, Executive Committee, City Planning Division

2:00 The Allegheny Conference—Its Objectives and Accomplishments

PARK H. MARTIN, M. ASCE; Executive Director, Allegheny Conference on Community Development, Pittsburgh, Pa.

3:00 The Louisville Area Development Association—An Action Agency

K. P. VINSEL, Executive Vice-President, Louisville Chamber of Commerce, Louisville, Ky.

Construction and Structural Divisions, Joint Session

2:00 P.M. **ROOF GARDEN**

Presiding: R. N. Bergendoff, M. ASCE, Member, Executive Committee, Structural Division

2:00 Design of Delaware Memorial Bridge

ELMER K. TIMBY, M. ASCE, Partner; and CHARLES H. CLARAHAN, M. ASCE, Chief Designer, Howard, Needles, Tammen and Bergendoff, New York, N.Y.

2:45 **Construction of Delaware Memorial Bridge**

HOMER R. SEELY, M. ASCE; Project Engineer, Howard, Needles, Tammen and Bergendoff, New York, N.Y.

3:30 **Design of York River Bridge At Yorktown, Va.**

MAURICE N. QUADE, M. ASCE; Partner, Parsons, Brinkerhoff, Hall and Macdonald, New York, N.Y.

4:15 **Construction of River Piers for the York River Bridge**

JOHN N. NEWELL, Chief Engineer, Massman Construction Co., Kansas City, Mo.

Hydraulics Division

2:00 P.M. **SOUTH ROOM**

Presiding: Wallace M. Lansford, M. ASCE, Chairman, Committee on Design, Hydraulics Division

2:00 **Symposium on Unique Features of South Holston Surge Tank System**

Basic Design and Operational Requirements

JAMES E. LUCAS, JR., Jun. M. ASCE; Civil Design Branch, TVA, Knoxville, Tenn.

Model Studies of Surge System

REX A. ELDER, Assoc. M. ASCE; Head, TVA Hydraulic Laboratory, Norris, Tenn.

Model-Prototype Comparisons and Water-Hammer Measurements

ARTHUR I. REZIN, Jun. M. ASCE; TVA Hydraulic Laboratory Staff, Norris, Tenn.

Model-Prototype Test Instrumentation

JAMES A. DALE, Head, Hydrographic Instruments Unit, TVA

Discussion

Soil Mechanics and Foundations Division

2:00 P.M. **CRYSTAL BALLROOM**

Presiding: Philip C. Rutledge, Assoc. M. ASCE, Chairman, Executive Committee, Soil Mechanics and Foundations Division

2:00 **Foundations for Flood Walls**

R. R. PHILIPPE, Assoc. M. ASCE, Engineer, Research and Development Division, Office, Chief of Engineers, Washington, D.C.; and R. F. JACKSON, Assoc. M. ASCE, Chief, Materials Investigation Branch, Louisville District, U.S. Corps of Engineers, Louisville, Ky.

2:45 **Compressibility of Two Compacted Clays**

H. C. WOODSUM, Instructor in Soil Mechanics, Purdue University, Lafayette, Ind.

3:30 **Discussion**

Prof. G. A. LEONARDS, Purdue University, Lafayette, Ind.

Prof. J. O. OSTERBERG, Northwestern University, Evanston, Ill.

Dinner and Dance

Thursday, June 14

CRYSTAL BALLROOM BROWN HOTEL

7:00 p.m. Cocktail Hour
8:00 p.m. Dinner
9:30 p.m. Dancing, Entertainment

This affair will be a highlight of the Convention. All members and their guests are cordially invited to attend. Dress will be informal. The cocktail bar will be located in the alcove of ballroom. Students are invited to attend the dinner-dance at half price.

Ticket price will be $7.50 per person; includes dinner and dancing. Cocktails extra.

Friday Morning, June 15

Air Transport Division

9:30 A.M. **LOUIS XVI ROOM**

Presiding: Herbert H. Howell, M. ASCE, Chairman, Executive Committee, Air Transport Division

9:30 **Planning of Naval Air Facilities**

H. C. SULLIVAN, Head Architect, Bureau of Yards and Docks, U. S. Navy, Washington, D.C.

10:15 **Design of Blue Ash Airport at Cincinnati**

11:00 **Air Navigation Aids**

W. J. TOWNSEND, Airways Operations Division, Region 4, Civil Aeronautics Administration, Fort Worth, Tex.

Waterways Division

9:30 A.M. **ROOF GARDEN**

Presiding: Carl B. Jansen, M. ASCE, Executive Committee, Waterways Division

9:30 **Practical Considerations in Design of Bulkheads**

JAMES AYERS, M. ASCE, Head, Waterfront Structures Section, Bureau of Yards and Docks, Washington, D.C.; and RALPH STOKES, M. ASCE, Consulting Engineer, Dallas, Tex.

10:15 **Slack-Water Improvement of Columbia River**

ORVILLE E. WALSH, Brigadier General, U. S. Army; Division Engineer, North Pacific Division, Portland, Ore.

11:00 **Local Flood Protection Projects at Falls of the Ohio**

S. M. BAILEY, M. ASCE, Chief, Engineering Division; C. L. COWAN, M. ASCE, Chief Hydraulics Branch; and R. E. KARLEN, Assoc. M. ASCE, Chief, Flood Control Design Section, Corps of Engineers, U. S. Army, Louisville, Ky.

Engineering Economics Division

9:30 A.M. **SOUTH ROOM**

Presiding: Louis Mitchell, M. ASCE, Chairman, Executive Committee, Engineering Economics Division

9:30 **Economic Justification of Turnpikes**

ENOCH R. NEEDLES, M. ASCE; Partner, Howard, Needles, Tammen & Bergendoff, New York, N.Y.

10:00 **Panel Discussion on Turnpike Financing**

THEODORE J. KAUER, M. ASCE; Director, Ohio State Highway Department, Columbus, Ohio.

BEN H. PETTY, M. ASCE; Professor of Highway Engineering, Purdue University, Lafayette, Ind.

HAROLD G. SOURS, M. ASCE; Consulting Engineer, Columbus, Ohio.

Weekly Luncheon Meetings of Civic Clubs

Tuesday: Lions Club, Brown Hotel; Downtown Optimists Club, Seelbach Hotel

Wednesday: Kiwanis Club, Brown Hotel; Optimists Club, Kentucky Hotel

Thursday: Rotary Club, Brown Hotel; Exchange Club, Kentucky Hotel.

Student Chapter, Faculty Advisers' and Contact Members' Conference

Thursday, June 14

9:30 A.M. **DERBY ROOM BROWN HOTEL**

Presiding: Wylie B. Wendt, Chairman of Student Activities Committee

All Student Chapter Faculty Advisers and Contact Members from the Ninth District and adjacent districts are invited to take part in this round-table discussion of student affairs.

Ladies' Entertainment

Wednesday, June 13

a.m. **Address of welcome and opening of Louisville Convention**
Crystal Ballroom, Brown Hotel

Noon **Membership luncheon**

p.m. **Ladies Tea**
At the home of Mr. and Mrs. George R. Bickel on Lime Kiln Road

Thursday, June 14

a.m. **Tour to historic Bardstown, Luncheon at Talbot Inn**

p.m. **Dinner Dance**
In the Crystal Ballroom of the Brown Hotel

Friday, June 15

a.m. **Tour of Bluegrass region of Kentucky**
Luncheon at Coach House

Inspection Trips and Tours

Thursday, June 14

10:00 a.m. **Tour to historic Bardstown, luncheon at Talbot Inn**

At Bardstown you will visit My Old Kentucky Home, Wickland, the home of several governors, and St. Joseph's Cathedral, noted for fine paintings donated by Louis Philippe. Tour will take about 5 hours.

Price, $5.00 per ticket, covers bus transportation and luncheon.

2:00 p.m. **Tour of Louisville**
Includes tour of Churchill Downs of Kentucky Derby fame, Seagram's distillery, the Brown & Williamson Tobacco Corp. and the University of Louisville. Tour will take about 2 hours.

Price, $1.00 per ticket, covers bus transportation.

4:00 p.m. **Inspection trip**
Of the new and modern *Courier-Journal* and *Louisville Times* publishing plant, and WHAS radio and television station. Located 3 blocks from Brown Hotel. Trip will take about one hour. No charge.

Friday, June 15

9:00 a.m. **Tour of Bluegrass region of Kentucky, luncheon at Coach House**
This will be an all-day affair with main features the University of Kentucky campus, the State Capitol at Frankfort, and the well-known thoroughbred horse farms in the area. Tour will take about 8 hours.

Price, $5.50 per ticket, covers bus transportation and luncheon.

2:00 p.m. **Inspection trip of Louisville Floodwall**
This will include construction features of the concrete floodwall, access opening facilities, earth levee, and pumping stations.

Price, $1.00 per ticket, covers bus transportation.

2:00 p.m. **Inspection trip to Paddy Run Steam Power Plant of Louisville Gas and Electric Co.**
This modern plant has many outstanding and interesting features. Trip will take about 3 hours.

Price, $1.00 per ticket, covers bus transportation.

2:00 p.m. **Inspection trip of the Ohio River harbor**
Includes the new Veterans Hospital now under construction, the river pumping station and purification plant of the Louisville Water Co., and the Beautiful Cherokee and Seneca Parks. Trip will take about 3 hours.

Price, $1.00 per ticket, covers bus transportation.

4:00 p.m. **Inspection trip**
Of the new and modern *Courier-Journal* and *Louisville Times* publishing plant, and WHAT radio and television station. Located 3 blocks from the Brown Hotel. Trip will take about one hour. No charge.

Hotel Accommodations and Convention Headquarters

Make Hotel Reservations Early

The Brown Hotel in Louisville is headquarters for this convention. Most events, unless otherwise noted, will be held in this hotel. All those planning to attend the Louisville Convention are urged to make requests for room reservations as early as possible.

To assure accommodations at the headquarters Hotel Brown, requests should be received by the hotel before May 28, 1951. Later applicants may have to be assigned to other hotels nearby.

Rates at the Brown start at $3.50 single and $5.50 double.

Requests for reservations should be mailed to:

MR. LAMARR BITTINGER
Brown Hotel
Louisville 2, Ky.

Requests should mention your attendance at the ASCE Louisville Convention. A special request form is printed on page 88 of this issue for your convenience.

Mammoth Cave Excursion

Saturday, June 16, 1951

An all-day trip to Mammoth Cave will be arranged for Saturday if a sufficient number of people register to take the trip. Summation of the registration will be made at noon on Thursday and those signing for the Mammoth Cave trip will be notified before Friday morning whether trip is scheduled and the definite arrangements. An approximate schedule of the trip is as follows:

Mammoth Cave Excursion

Leave Brown Hotel by bus about 9:00 a.m. (Saturday, June 16). Following U. S. Highway 31-W for about 100 miles via Fort Knox, Elizabethtown, and Munfordville, bus will arrive at Mammoth Cave about noon. Luncheon at Mammoth Cave Inn. Trip through caves in afternoon. Leave Mammoth Cave by bus about 4:30 p.m. and arrive back at Brown Hotel about 7:30 p.m.

Approximate price, $7.50 per person, includes bus, luncheon, and Cave trip.

Louisville Convention Committees

Charles W. Lovell, *General Chairman*
Craig P. Hazelet, *President, Kentucky Section*
Wallace W. Sanders, Floyd F. Schrader, *Vice Chairmen*

Executive Committee

Samuel M. Bailey	W. Roscoe McIntosh
George R. Bickel	Marion D. Ross
Charles H. Blackman	Wallace W. Sanders
Dwight H. Bray	Floyd F. Schrader
Cedric L. Cowan	Robert E. Shaver
J. Frank Grimes	William O. Snyder
Craig P. Hazelet	Daniel V. Terrell
Charles W. Lovell	J. Stephen Watkins

Entertainment Committee
W. Roscoe McIntosh, Chairman

Finance Committee
J. Stephen Watkins, Chairman

Hotel and Arrangements Committee
Robert E. Martin, Chairman

Ladies Committee
Mrs. S. M. Bailey, Chairman

Publicity Committee
Wallace W. Sanders, Chairman

Reception Committee
Mr. and Mrs. Craig P. Hazelet, Chairman

Registration Committee
Matthew I. Rorabaugh, Chairman

Student Activities Committee
Wylie B. Wendt, Chairman

Technical Committee
Samuel M. Bailey, Chairman

Transportation Committee
Charles H. Blackman, Chairman

Distinguished Guests Committee
F. Clarke Dugan, Chairman

Convention Secretary
John H. Clark, III

Cooperation with other Sections Committee
Daniel V. Terrell, ASCE Vice President, Chairman

SOCIETY NEWS . . .

Constitution for UPADI Adopted at Organization Conference in Havana

Representatives of ASCE and the other constituent societies of Engineers Joint Council, the Engineering Institute of Canada, and twelve South and Central American countries took part in a UPADI (Union Panamericana de Asociaciones de Ingenieros) conference in Havana, Cuba, April 19–22, for the organization of a Western Hemisphere Federation of Engineers and Engineering Societies. The principal accomplishment of the conference was adoption of a constitution, which will be in effect only until the next convention two or three years from now. It is expected that by then a better worded constitution will be available for adoption.

Formation of a Western Hemisphere federation has been under consideration for several years and was brought close to completion at a convention in São Paulo, Brazil, in July 1949. Though most of the South American societies indicated their willingness to subscribe to the tentative constitution drawn up at that time, the EJC societies and the Engineering Institute of Canada favored formation of the proposed federation on a somewhat simpler basis than was contemplated in the tentative constitution.

The constitution adopted at Havana provides for a nine-man board of direction, appointed for a three-year term. One director will be appointed by the engineering society representing each of the following countries: The Argentine, Brazil, Canada, Colombia, Cuba, El Salvador, Honduras, the United States, and Uruguay. Headquarters for the present will be at Montevideo, Uruguay.

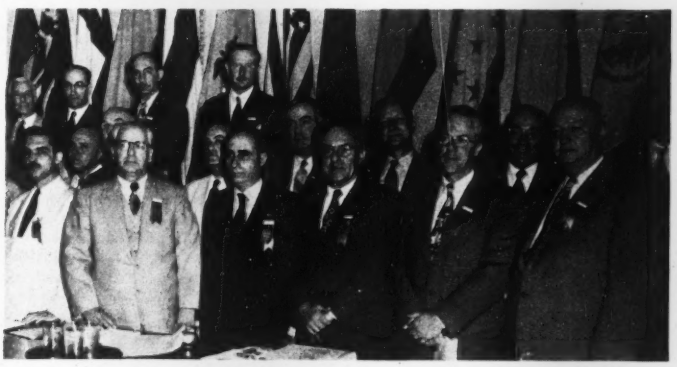
An invitation to hold the next conference in New Orleans, La., was presented for the United States delegation by James M. Todd, president of EJC, and enthusiastically accepted by the conference. Other actions taken at the Havana Conference included setting up a foundation to obtain financial support for principal UPADI activities by contributions from industry, governments, and other sources. UPADI will not have any regular dues or permanent secretariat.

The Havana conference gave unanimous approval to the spirit of UPADI as expressed in its aims and purposes. As stated in the constitution, these objectives are to encourage, promote, expand and guide the work of the engineers of the Western Hemisphere; to encourage the holding of periodical Pan-American engineering conventions; to promote individual and collective visits, interchange of teachers, lectures, engineering literature, engineers and students; and to organize connections between engineering associations at administrative level for the purpose of advancing their common purposes.

F. Saturnino de Brito, M. ASCE, of Rio de Janeiro, Brazil, was provisional chairman of the UPADI organization. The chairman of the EJC delegation to the conference was Adolph J. Ackerman, member of ASCE and ASME, of São Paulo, Brazil. The delegation from the EJC societies was, for ASCE, President Gail A. Hathaway and Executive Secretary William N. Carey, with J. J. Steinberg, M. ASCE, adviser; for ASME, James M. Todd, President of EJC, William H. Carson, A. J. Ackerman, and Stewart E. Reimel; for AIEE, Titus G. LeClair, President; for AIME, Fred Agthe; and for AIChE, S. L. Tyler, Secretary. Delegates from the Engineering Institute of Canada were James A. Vance, President, and L. Austin Wright, General Secretary.

Representatives were also present from the Union Argentina de Asociaciones de Ingenieros, Federacao Brasileira de Engenheiros, Sociedad Colombiana de Ingenieros, Sociedad Hondurena de Ingenieros, Instituto de Ingenieros de Chile, Sociedad Panamena de Ingenieros y Arquitectos, Asociacion de Ingenieros del Uruguay, Sociedad Salvadorena de Ingenieros, Sociedad de Ingenieros de Bolivia, Sociedad Dominicana de Ingenieros y Arquitectos, Colegio de Ingenieros de Puerto Rico, and Sociedad Cubana de Ingenieros.

SOME OF DELEGATES TO UPADI CONFERENCE in Havana are photographed in headquarters of Cuban Engineering Society. In front row are Manuel Puente, M. ASCE, consulting engineer of Havana and temporary chairman of meeting; F. Saturnino de Brito, M. ASCE, of Rio de Janeiro, Brazil, temporary chairman of UPADI; James A. Vance, President of EIC; ASCE President Gail Hathaway; Titus G. LeClair, President of AIEE; and James Todd, President of EJC. Adolph Ackerman, who headed EJC delegation to conference, is shown making address in photo at left. Meeting proceedings were in Spanish, which was translated into English and Portuguese.



Annual Convention Committee Meets in New York

PRELIMINARY PLANS FOR 1951 ANNUAL CONVENTION, to be held in New York City, October 22-25, are drafted by Annual Convention Committee at meeting in ASCE board room. Shown, left to right, are Arthur J. Fox, Jr., Horace A. Vanderbeek, Robert H. Dodds, Roger Gilman, Ford Bartlett, Mrs. William S. LaLonde, Jr., J. P. Riley, Professor LaLonde (chairman), J. M. Garrelts, Richard Hazen, and John Zehner.

New Engineering Mechanics Division Begins Operation

Operation of the new ASCE Engineering Mechanics Division, authorized by the Board of Direction at its Chicago Meeting, got under way at a recent two-day organizational meeting of the executive committee of the Division held at the Illinois Institute of Technology in Chicago. Linton E. Grinter, research professor of civil engineering at Illinois Institute of Technology, is chairman of this first executive committee of the Division. Other members of the committee are Ralph E. Fadum, Arthur T. Ippen, Douglas McHenry, and Nathan M. Newmark. Dr. Clayton O. Dohrenwend, of Rensselaer Polytechnic Institute, has been appointed Division secretary.

During the two-day meeting, objectives, policies and bylaws were established; the subcommittee structure was determined; and action was initiated for joint committee representation, cooperation with the National Congress of Applied Mechanics, and Division participation in the ASCE Centennial Celebration in 1952. Tentative plans were also formulated for the inaugural meeting of the Division at the ASCE Annual Convention in October 1951.

The organization of the Division provides for the establishment of an advisory board, with the function of counseling the executive committee on matters concerning awards, policies, appointments, and technical programs. It was recommended for approval by the ASCE Committee on Division Activities that the following six technical committees be organized: (1) Committee on Applied Mathematics and Numerical Methods, for developing and encouraging the application of analytical tools to civil engineering problems; (2) Committee on Experimental Analysis of Analogues to foster the development and use of experimental methods and the utilization of techniques from other fields; (3) Committee on Fluid Dynamics to promote the study by analytical and experimental means of basic problems in the flow of liquids and gases; (4) Committee on Mechanical Properties of Materials to investigate and correlate studies of the fundamental properties of engineering materials and to disseminate this information to the profession; (5) Committee on Plasticity Related to Design to study the phenomenon of plastic behavior in structures and the application of the findings to design; and (6) Committee on Structural Dynamics to study the behavior of structures under impulsive loading including blast, earthquake and periodic forces.

Appointment of members to the technical committees awaits official approval of the subcommittee substructure as recommended. Members of the Society with a special interest in engineering mechanics are urged to give active support to the activities of the new Division by informing Dr. Dohrenwend of their desire to affiliate with it.

Linton E. Grinter

C. O. Dohrenwend

Arthur T. Ippen

Nathan M. Newmark

Ralph E. Fadum

Douglas McHenry

Use of Interim Report on Percentage Fees Outlined

The Society's "Revised Interim Report: A Method of Estimating Fees for Professional Civil Engineering Services" was published in its present letter-size format partly because, if desired, it may be readily incorporated into contracts or proposals for engineering services. Society headquarters has been frequently informed of this use of the report. At the same time there is occasional evidence that the report has been confused with "a contract form," which it is not, as will be noted if the report is tested for essential elements of a contract.

The important features of the Interim Report are, first, an expression of opinion as to (*a*) sound basic practice in the grouping of types of work under two general categories, (*b*) services usually rendered under the fee, and (*c*) services which it is recommended be paid for in addition to the fee, and second, the statistical summary of median rates of fees reported by 126 firms rendering professional engineering services within the continental United States. The summary is expressed in the form of a table and curves of values obtained from the survey.

The incorporation of these reports into proposals or contracts is, therefore, a con-

venience to engineering firms that concur in the provisions of the report or in most of its features but may include elsewhere in the proposal or contract a statement of divergencies from its provisions.

It is well to reiterate that the Interim Report does not contain any recommendations of rates of fee. The median rates shown were obtained by standard statistical methods.

Naturally decision as to proper fee for a project is of primary importance to both engineer and client. Of equal importance to both is a clear mutual understanding of the scope of the project and exactly what is required of the engineer on it. Such an understanding can be obtained only if the engineer informs himself fully regarding the project. The necessary mutual understanding, together with the amount of the fee agreed upon, should be set forth clearly in a written contract, as recommended in the Interim Report.

Almost 2,000 copies of the Interim Report have been sold since its adoption by the Board of Direction in October 1949. Copies of this report (Society publication 1949-1, revised) are available from the Executive Secretary, ASCE, 33 West 39th Street, New York 18, N.Y., at 10 cents a copy, 35 cents for five copies, or 5 cents for lots of ten or more.

Formation of Technical Group to Pass on Use of Engineering Manpower Weighed

Establishment of a competent board of technically qualified persons, both military and civilian, with final authority for calling technically trained personnel to active duty, was urged as essential to national safety by Carey H. Brown, M. ASCE, chairman of the Engineering Manpower Commission of Engineers Joint Council, in a recent letter to Gen. George C. Marshall, Secretary of Defense. The grave consequences of dissipation and wasteful use of the nation's trained and skilled young men were cited by Mr. Brown as reasons for the Commission's recommendations.

Pointing out the concern of the Commission over the lack of a long-term government policy, concerning the selection and utilization of technical and scientific personnel in defense work, the letter states, "that a greater degree of mobilization is approaching, which if carried out to the full would leave this nation incapable of increasing its production and its development of new weapons.

"This situation is critical. Reservists are being called to duty continually. Those who have been granted a delay in their call to duty are being told that such delays are only temporary and will seldom be renewed. It is of the utmost importance that this situation be given the most serious attention."

General Marshall's reply to the Engineering Manpower Commission reads in part:

"I appreciate having the benefit of your thinking on the reserve recall problem and your suggestion that a board 'composed of technically qualified personnel from the armed services and from the civilian activities of the nation' be established in my office to develop policy and criteria, as well as have final authority for the calling of technically trained personnel to active duty.

"As you probably know, Assistant Secretary Rosenberg has been considering the establishment of a deferment review board at Department level and has requested assistance from Dr. Trytten and other members of your Council in developing a method of screening cases at lower levels so that only the more important ones would be referred to the top-level group. Clearly, it would not be possible for such a board to personally weigh and judge each case that would come up to it from the three services if the right of appeal were available to all cases covered by the Labor Department List of Critical Occupations and the Department of Commerce List of Essential Activities. The important function of the Board under such circumstances might well be buried by an impractical administrative load.

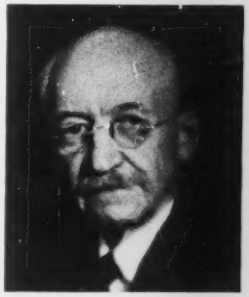
"The Department of Defense is devoting every effort to giving substance to the President's National Manpower Mobilization Policy as related to the recall of reservists. I know that Mrs. Rosenberg will appreciate your assistance and your understanding of the complexities of the problems."

Established in September 1950 at the request of the Manpower Office of the National Security Resources Board, the Engineering Manpower Commission of EJC consists of three members from each of the five constituent EJC organizations and from the American Society for Engineering Education. The Commission is charged with the responsibility of developing policies and procedures for securing the most effective use of engineering skills during the emergency, and taking necessary steps within the scope of EJC to put such policies and procedures into practice.

Dean F. E. Turneaure, ASCE Honorary Member, Dies

ASCE Honorary Member Frederick E. Turneaure, dean emeritus of the College of Engineering at the University of Wisconsin, died in a hospital at Madison, Wis., on March 31, at the age of 84. He was a graduate of Cornell University. Starting his teaching career at the University of Wisconsin in 1892 as professor of bridge and sanitary engineering, Dean Turneaure headed the Engineering School there for 33 years prior to his retirement in 1937. For 19 years he was also an ex-officio member of the State Highway Commission.

An authority on the theory of structures and on the theory and practice of reinforced concrete, Dean Turneaure received the Turner Medal of the America Concrete Institute in 1930 for "distinguished service in formulating sound principles of reinforced concrete design." He had also contributed to the PROCEEDINGS of the Society and was co-author of several widely used engineering texts.



F. E. Turneaure, Hon. M. ASCE
(1866-1951)

Becoming an Associate Member of ASCE in 1902 and Member in 1913, Dean Turneaure was made Honorary Member in 1933. He filled many committee assignments for the Society, including the chairmanship of the Committee on Research and of the Special Committee on Steel Column Research. He had also been president of the American Society for Engineering Education and the Wisconsin Engineering Society.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

Legislation

As a result of General MacArthur's return, congressional thought has been concentrated on major policies relating to foreign relations and military operations with a consequent slowing down of other legislative matters.

The Economic Cooperation Act (S. 1164) recently introduced would extend ECA coverage to any friendly nation. It would also place the Point IV program, the Voice of America, and the Institute of Inter-American Affairs under ECA. In addition, it provides for the establishment of three additional government corporations to be known as the Institute of African Affairs, the Institute of Far Eastern Affairs, and the Institute of Middle Eastern Affairs, all under the general direction of ECA.

The Defense Housing Bill (S. 349) passed the Senate with the limitations mentioned in this column last month. Hearings are under way in the House.

The Assignment of Claims Act of 1940 (H.R. 3692). A bill to amend this act to cover contracts recently entered into by the defense agencies, has been approved by the Judiciary Committee of the House. It would facilitate the financing of defense contracts by banks by protecting the assignee against various claims.

National Water Resources Basic-Data Act of 1951. No action has been taken on this act (H.R. 1637), which was introduced several months ago.

Central Arizona Reclamation Project (H.R. 1500). The House Interior Committee voted to delay action on this act until Arizona and California can obtain a court decision on their rights to Colorado River water or until they reach agreement on their shares.

Controls

A Board of Appeals and an appeals procedure is established by NPA Regulation No. 5, dated April 25.

A preview of the Controlled Materials Plan, which is to go into effect July 1, is afforded by press conferences recently held by NPA officials. The construction industry as well as many others must be prepared to operate under a new type of regimentation. The new CMP is in essence a budgeting plan for dealing with three key materials—steel, copper, and aluminum. The present priority system (D.O. ratings) is breaking down and could not stand much added pressure. It largely ignores the supply factors and the proper time-scheduling of orders. The new CMP system measures supply against demand and authorizes production of approved items by quarter-year periods. It differs somewhat from the World War II CMP system, in that it will cover only three basic metals and their use for defense and defense-related needs. It will be "open-ended" in that it recognizes we are operating a dual economy in which non-defense items should be allowed a supply of materials. For defense and defense-supporting items, the system will provide definite authorizations project by project, scheduling the needed metals as needed. The scheduling element is one of the plan's greatest virtues. For non-defense items a free market will exist—that is, while a certain percentage of steel, copper, and aluminum will be reserved for this part of the economy, no authorization will be issued for specific items or projects; the buyers must scramble for materials.

The CMP system is described by its advocates as comparable to a cashier's check, while the old priority system resembles issuing a blank check without looking at the bank balance or without regard to how many checks have already been issued. One justification for a CMP plan relates to the time needed to get it into successful operation, for if a more urgent military program were suddenly necessitated it would be difficult to accomplish under our present priority system.

Claimant agencies have been or will be designated (see CIVIL ENGINEERING for January, page 63). They will ascertain the needs and wants for the metals. NPA will adjust the figures as necessary to bring the authorizations within the supply for any given quarter. The various prohibition, limitation and licensing orders will probably remain in effect. The D.O. ratings will eventually be replaced by a special CMP priority, though perhaps not immediately.

A special CMP order No. 6 dealing with construction and other initial orders is scheduled for issuance early in May. One form will be sent to builders for a listing of requirements. Actually the plan will not be fully effective until the last quarter of the year at the earliest, as in the third quarter operators will use materials previously ordered.

One of the greatest difficulties facing the construction industry under the CMP plan lies in the fact that construction generally deals with "tailor-made" items. While an automobile manufacturer or even a home builder could get steel items from the non-controlled supply by shopping around, it is difficult to see how a builder of a bridge, a large building or a sewage disposal plant could get his special products unless he had a CMP rating—that is, unless the project were classified as defense or defense-supporting. These matters will be discussed next month when the actual regulations are available.

ASCE MEMBERSHIP AS OF APRIL 9, 1951

Members	7,819
Associate Members	10,069
Junior Members	14,049
Affiliates	68
Honorary Members	37
Fellows	1
Total	32,043
(April 10, 1950	28,440)

Civil Defense

Civil defense has had hard sledding amid confusion of objectives and general apathy on the part of the public. Its requests for funds are meeting resistance and are likely to be cut severely. Large bomb shelters are being de-emphasized; protection will be developed within existing buildings. A conference on shelter construction is now being held, and a National Conference on Civil Defense will take place in Washington in May. A bill providing for dispersal of government buildings in the National Capitol area as a prevention against widespread destruction under attack has been shelved by recent action of the Senate.

Interstate Compacts

A recent decision of the U.S. Supreme Court (No. 147—delivered on April 9) puts interstate compacts on firmer ground. The Auditor of West Virginia refused to make funds available for a Sanitation Commission to which West Virginia and seven other states were parties, alleging that under the compact the police power of the state was improperly delegated, etc. In the decision it was stated that a State Court could not be the final interpreter of its Constitution where an interstate compact was involved, and the compact was held not in violation of the state constitution, reversing the highest West Virginia court. In a concurring opinion, Justice Jackson said that in the absence of a provision of her

constitution, which would give the other states clear notice of any defect in her authority to contract, West Virginia should be estopped from now claiming release from her contractural obligation to the other states. (See item elsewhere in this issue.)

Washington, D.C.
April 25, 1951

Horace King, Hon. M. ASCE and Educator, Is Dead

Horace Williams King, Honorary Member of ASCE and professor emeritus of hydraulic engineering at the University of Michigan, died in Pasadena, Calif., on April 22, at the age of 77. A graduate of the University of Michigan, class of 1895, Mr. King filled engineering assignments in Nicaragua, China, and the Philippines in his early career and was also with the U.S. Reclamation Service (now the Bureau of Reclamation).

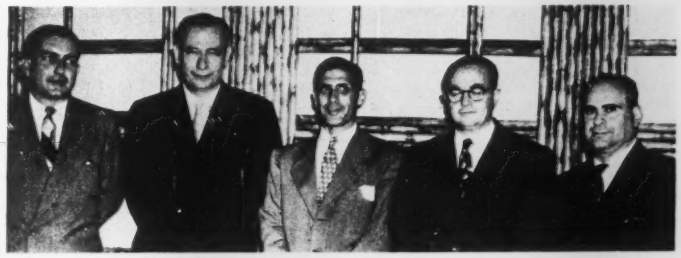
An authority in hydraulics, he was professor of hydraulic engineering at the University of Michigan from 1912 until his retirement in 1939. During the same period, Professor King had a private consulting practice in Ann Arbor. First American engineer to advocate use of the

Horace King, Hon. M. ASCE
(1874–1951)

Manning formula for flow in pipes and open channels, he was largely responsible for its adoption in this country. His numerous publications include a *Handbook of Hydraulics* and a widely used text entitled *Hydraulics*.

A member of ASCE since 1913, Professor King was elected Honorary Member in 1944.

ASCE Sections in South America Are Active



PROGRAMS OF FAR-OFF ASCE SECTIONS—in Venezuela and Brazil—reflect keen interest of South American engineers in the Society and the profession. Photographed at annual dinner of Venezuelan Section (top photo) are, left to right, Arturo Valery, secretary of Section; Gerardo Sanson, Minister of Public Works; Edmundo Curiel, president; Pedro E. Herrera, Minister of Development and speaker of evening; and Manuel F. Mejias, treasurer. Guest of honor for occasion was Royce J. Tipton, consulting engineer of Denver, Colo. Lower view shows group attending recent dinner meeting of Brazil Section, at which certificates of life membership were presented to Dr. Francisco Teixeira da Silva Telles and Leon C. Heilbronner. In absence of Section president Adolph J. Ackerman, Clyde M. Wood and Raymundo Jose d'Araujo Costa, secretary and treasurer, made presentations and spoke.

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Alabama	Mar. 30	...	Spring meeting. Delegates from Georgia Institute of Technology, Alabama Polytechnic Institute, University of Alabama, and Mississippi State Student Chapters were present. Program included inspection of laboratories and open house displays, luncheons, technical sessions, and evening banquet.
Buffalo	Mar. 20	35	E. O. Rhodes, technical adviser, Tar Products Division, Koppers Co., Inc., presented an illustrated talk on production and application of enamel coatings on steel and cast-iron pipe conduits.
Cincinnati	Mar. 7	93	Joint meeting with University of Cincinnati Student Chapter. Edgar Parks and Roland Wadsworth, Jr., spoke on the construction of the Ford automatic transmission plant, and highway construction.
Cleveland	Mar. 9	...	"The History of Architecture through Masonry" was described by Anthony Ciresi, Cleveland architect.
Connecticut	Mar.	...	ASCE President Gail A. Hathaway was guest speaker at dinner meeting.
Duluth			New officers are Harry Walker, president; Clay C. Boswell, first vice-president; A. W. Hurtley, second vice-president; John E. Bovee, secretary; and Robert B. Rhode, treasurer.
Indiana	Apr. 10	85	Samuel C. Hadden, chairman of the Indiana State Highway Commission, outlined the history of salaried engineers in public service.

Coming Local Section Events

Central Ohio—Joint meeting with Ohio State University Student Chapter at Pomerene Hall, Columbus, May 17, at 6 p.m.

Cleveland—Joint meeting with Case Institute of Technology Student Chapter in Tomlinson Hall, May 25, at 8 p.m., preceded by dinner at 6:30 p.m.

Columbia—Meeting in Richland, Wash., on May 10.

Connecticut—Meeting at the Hotel Bond, Hartford, May 22.

Dayton—Joint meeting with the University of Dayton Student Chapter, May 21.

Illinois—Weekly luncheons every Friday at the Chicago Engineers Club, at 12 noon.

Intermountain—Meeting in Salt Lake City, May 18.

Los Angeles—Dinner meeting at the California Institute of Technology, Pasadena, May 9.

Maryland—Meeting in the Engineers Club of Baltimore, May 9, at 8 p.m., preceded by dinner at 7 p.m.

Metropolitan—Meeting in the Engineering Societies Building, New York City, May 16, at 8 p.m.

Mid-Missouri—Meeting in Jefferson City, May 25.

Mid-South—Field trip of Little Rock Branch to Bull Shoals Dam, June 15 and 16.

Northwestern—Meeting at the Coffman Memorial Union, University of Minnesota, the first Monday of each month.

Oklahoma—Joint meeting of the Oklahoma City and Tulsa Branches in Tulsa, May 11.

Philadelphia—Meeting at the Engineers Club, Philadelphia, May 8. Meeting of Delaware Sub-Section May 15.

Pittsburgh—Meeting at the William Penn Hotel, Pittsburgh, May 22. Inspection tour of the H. J. Heinz plant in Pittsburgh, May 19, for Junior Members.

Providence—Annual banquet at the University of Rhode Island, May 22.

Sacramento—Regular luncheon meetings at the Elks Club every Tuesday, at 12:30 p.m.

Syracuse—Meeting in Syracuse May 24.

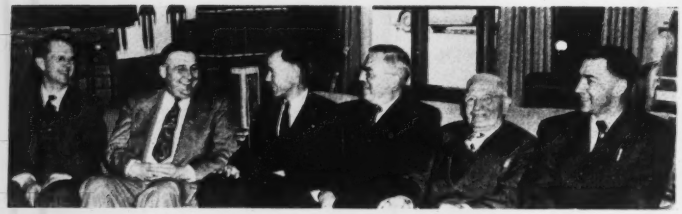
West Virginia—Afternoon and evening meeting on May 25. Group will meet at Blue Stone Dam near Hinton, W.Va., at 2 p.m. for inspection of dam. Evening program will consist of dinner meeting at Black Knight Country Club at Beckley, with Col. Walter Kreuger, Jr., head of Huntington office of Corps of Engineers, speaking.

Scheduled ASCE Conventions

SUMMER CONVENTION
Louisville, Ky., June 13–15
(Board of Direction meets June 11–12)

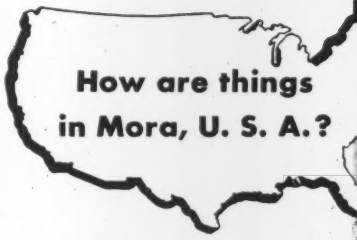
ANNUAL CONVENTION
New York, N.Y., October 22–25

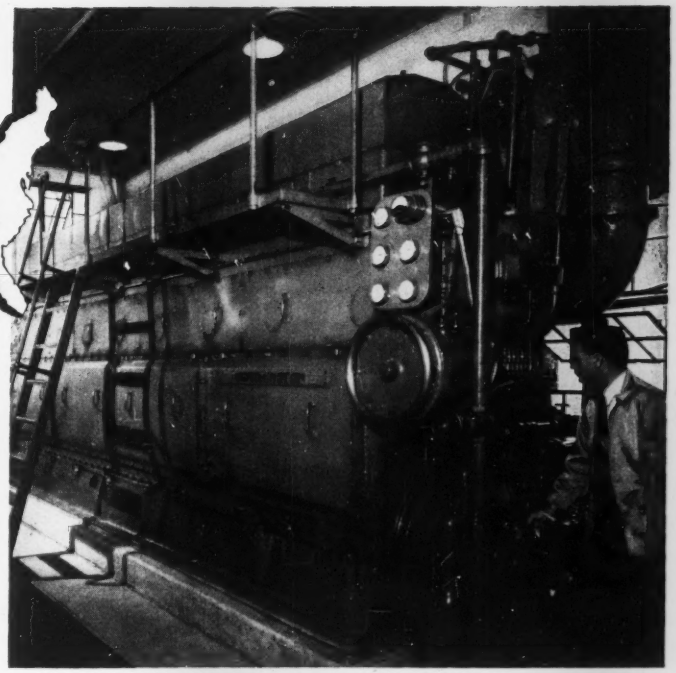
SPRING CONVENTION
New Orleans, La., March 5–7, 1952



PROGRAM AT RECENT MEETING OF MONTANA SECTION in Billings features talk by ASCE Executive Secretary William N. Carey on Engineers Joint Council program to facilitate maximum use of scientific and engineering personnel in defense effort. From left to right are C. G. Anderson, regional engineer for Bureau of Reclamation at Billings; Paul Johnson of Billings, past-president of Section; O. C. Reedy, president of Billings Branch of Section; Secretary Carey; R. T. Hurdle of Billings, vice-president of Section; and G. J. Hoge of Great Falls, secretary-treasurer of Section.

Maine	Mar. 29	24	Dinner meeting. President Gail A. Hathaway discussed "Unity in the Engineering Profession" and his recent trip to the international engineering conferences in India.
	Apr. 11	170	Joint conference with the Maine Water Utilities Association.
Mid-South	Mar. 15–16	86	Spring meeting. Morning technical session speakers included J. N. Hicks, John A. Roebling's Sons Co., Trenton, N.J., who talked on "Prestressed Concrete," and Col. L. H. Foote, district engineer, Corps of Engineers, Memphis, Tenn., who described the Memphis Harbor project. President Gail A. Hathaway was speaker at luncheon. "Modern Practices in Welded Steel Structures" was presented by N. J. Law, division engineer, American Institute of Steel Construction, St. Louis, Mo. A panel discussion on modern cements was conducted by C. E. Wurple, technical director, Marquette Cement Manufacturing Co., Chicago, with participation of H. N. Howe, structural engineer, Memphis, Tenn.; E. F. Bespalow, Choctaw Inc., Memphis; and Bryant Mather, Concrete Division, Waterways Experiment Station, Clinton, Miss. Inspection tours of Memphis Harbor project and recently completed Crump Boulevard.
Mohawk-Hudson	Mar. 22	...	Student paper competition at Union College. R. W. Wilkinson and M. P. Wirz, of Rensselaer Polytechnic Institute, and R. W. Gartner, of Union College, won first, second and third prizes, respectively for papers on the Mystic River Bridge, prestressed concrete, and the Proctor soil test.
Nebraska	Apr. 18	35	Dinner meeting with Eldrige Lovelace, member of St. Louis consulting firm, Harland Bartholomew & Associates, speaking on city planning.
Northwestern	Apr. 2	57	Hugo Erickson, city engineer, Minneapolis, Minn., gave an illustrated talk on proposed projects. George Shepard, city engineer, St. Paul, discussed the city's improvement program.
Philadelphia Delaware Sub-Section	Mar. 27	62	Joint meeting with the University of Delaware. ASCE Director Francis S. Friel discussed the recent Indian conferences.
Pittsburgh	Apr. 10	27	C. R. Woods, planning director, City Planning Department, Pittsburgh, Pa., explained a proposed zoning ordinance for the city before joint meeting of Section with Engineers' Society of Western Pennsylvania.
	Apr. 12	38	Junior members meeting featuring William A. Conwell, general engineer, Duquesne Light Co., as speaker.
Puerto Rico	Apr. 7	23	Inspection trip to site of Rio Grande de Loiza Dam, under guidance of engineers representing Sollitt, Oversis & Buck, Seifert & Jost, consultants on project. Luncheon picnic-style.





Rates Cut, Profits UP!

Things are as good in Mora, Minnesota as the song says they are in Glocca Mora.

Worthington Diesel engines operated by the municipal power plant in this progressive community have helped produce the lowest electric rate of any full Diesel municipal power plant in the state.

A Worthington 4-cycle supercharged engine, operating at low load factor of 42.6%, produced in 1950 5% more power per gallon of fuel than a 2-cycle engine operating at 59.4% load factor. Following the installation of the Worthington engine, rates were cut in 1949, yet net profits, in 1950, were greater than ever.

Worthington four-cycle supercharged engine is particularly well suited to the needs of a growing community like Mora —whose peak kw load has increased an average of 11% a year in recent years. Even when over-powered, a plant can operate at very low fuel cost and have the added engine capacity when needed without additional investment.

When you buy a Worthington 4-cycle supercharged engine, you benefit, too, from the *longest experience* of any manufacturer with this type of engine. For any engine application, call on Worthington—an engine for any fuel: oil (crude or regular), gas or "dual fuel". Worthington's complete line of engines assures you of the most economical operation no matter what fuel you use.

If gas or any combination of gas and oil offer fuel economies, consider Worthington gas or dual fuel engines. Only Worthington offers such exclusives as dual plunger pumps, gas micro-metering valves for each cylinder and thermal air controls —all built to give optimum performance for the fuel used.

For further details of the dependable, economical Diesel performance that proves *there's more worth in Worthington*, contact Worthington Pump and Machinery Corporation, Engine Division, Buffalo, New York.

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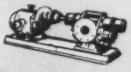
ECONOMICAL CONTINUOUS POWER
Diesel Engines, 150 to 2640 hp
Gas Engines, 190 to 2880 hp
Dual Fuel Engines, 345 to 2640 hp

WORTHINGTON-BUILT AUXILIARIES

Balanced Angle Compressors


Oil Transfer Pumps

Cooling Water Circulating Pumps

Evaporative Type Engine Water Coolers

Sacramento	Mar. 6	110	Floods in Central Valleys were discussed by Randolph H. DeWante, supervising hydraulic engineer, Corps of Engineers, Sacramento, Calif.
	Mar. 13	111	ASCE Director Milton T. Wilson outlined the history of the Upper Colorado River Compact.
	Mar. 20	105	"Recent Developments in Steam Power" were described by C. C. Whelchell, chief, division of steam engineering, Pacific Gas & Electric Co.
San Diego	Mar. 27	29	Student paper contest. Curtis Williams, of San Diego State College chapter, received first prize for his paper on "Rubberized Roadways." Philip W. Helsley reported briefly on activities of California Legislative Council.
Southern Idaho	Mar. 16		Newly elected officers include H. C. Clare, president; Clifford R. Salmen, first vice-president; Lynn Crandall, second vice-president; Wayne I. Travis, secretary; and Linne F. Erickson, treasurer. H. C. Clare, state sanitation engineer for Idaho, presented paper on fluoride treatment of water supplies.
Tacoma	Mar. 13	31	Dinner meeting. Samuel C. Gill, lieutenant commander, USN, gave a speech on the Navy's oil explorations in Alaska.
Tennessee Valley Knoxville Sub-Section	Mar. 14	...	"Water Transport—One Component of our National Resources" was presented by A. J. Wagner, chief Navigation and Transportation Branch, TVA.
	Apr. 11	63	Jack Partridge, program chairman, read paper on railroads—prepared by J. B. Sullivan, railroad consultant, who was unable to attend meeting.
Toledo	Feb. 7	18	Dinner meeting. O. W. Irwin, president, Rail Steel Bar Association, was speaker of evening.
	Mar. 7	21	Dinner meeting featuring Arthur H. Niles, superintendent of Toledo's Sewage Treatment Plant, as speaker.
Wisconsin	Mar. 22	500	Joint meeting with Greater Milwaukee Committee featuring a typical expressway segment model. Two expressway segments are being planned for the city. Speakers included James S. Whitney, associate partner, Ammann & Whitney, expressway designers; Guy Kelcey, of Newark, N. J., member of firm planning the route and making traffic studies; E. G. Pfautz, Wisconsin State expressway engineer; and Raleigh W. Gamble, Milwaukee expressway director.

ASCE Student Chapter Installed at Howard University

FRANK L. WEAVER, ASCE DIRECTOR FOR DISTRICT 5, installs at Howard University Society's 131st Student Chapter, following authorization of Board at Houston Convention. Participants in ceremonies include, left to right, Bernard Crummet, president of George Washington University Student Chapter; Dr. Walter T. Daniels, M. ASCE, sponsor of Howard University Student Chapter; Kenneth Felton, president of University of Maryland Chapter; Dean W. S. Nelson of Howard University; L. K. Downing, dean of School of Engineering and Architecture; Mr. Weaver; Vincent B. Smith, secretary of District of Columbia Section of ASCE; Napoleon Johnson, president of new Student Chapter; Frank F. Hurka, president of Chapter at Johns Hopkins University; and Charles J. Stevens, president of District of Columbia Section.

Student Chapters Honored for 1950 Activities

For outstanding activities during 1950, a selected number of ASCE Student Chapters have been named for special commendation. Award of these honors follows action taken by the Society's Committee on Student Chapters at a recent meeting in Cleveland.

The awards are in the form of engrossed Certificates of Commendation and President's Letters of Honorable Mention. The Certificates go to Chapters at the following colleges and universities:

University of Dayton
Bucknell University
Carnegie Institute of Technology
Iowa State College
Illinois Institute of Technology

North Dakota State College
Virginia Military Institute
Tulane University
Georgia Institute of Technology
Cooper Union

Massachusetts Institute of Technology
New York University
California Institute of Technology
Texas Technological College
University of Colorado

Student Chapters receiving the President's Letters of Honorable Mention are as follows:

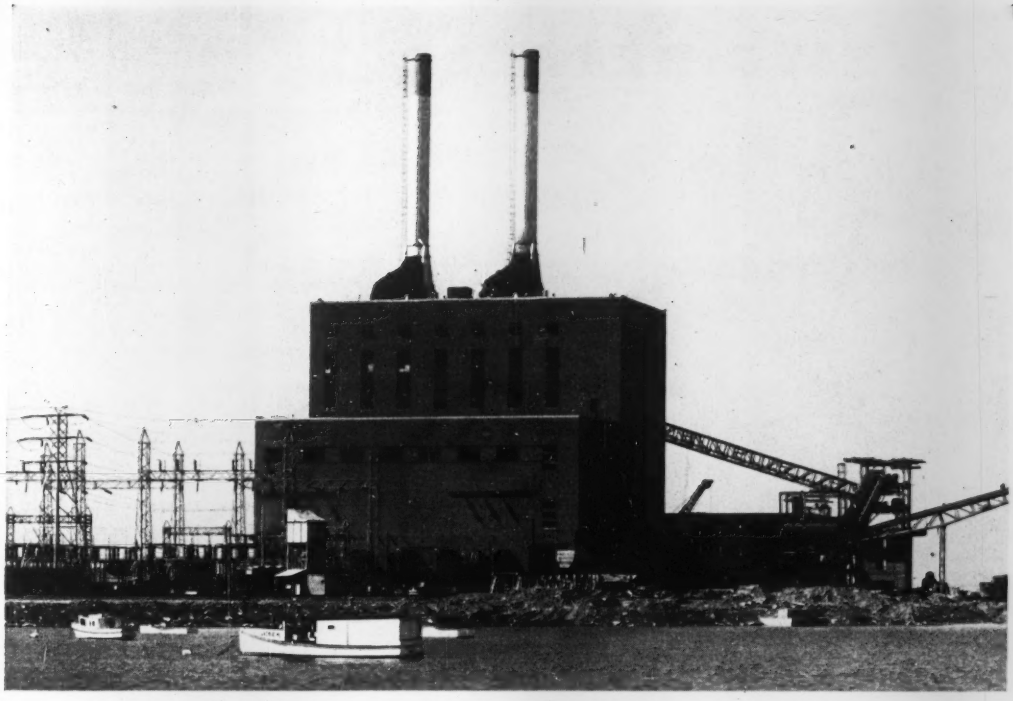
Rutgers University
Case Institute of Technology
West Virginia University
Newark College of Engineering
University of Detroit

Kansas State College
University of Kansas
Wayne University
University of Missouri
Purdue University

Mississippi State College
University of Alabama
Alabama Polytechnic Institute
University of Virginia
Duke University

University of Florida
Clarkson College of Technology
Manhattan College
Northeastern University
Worcester Polytechnic Institute

University of Arizona
University of Nevada
Stanford University
University of Alaska
University of California
University of Wyoming



New Steam Generating Plant
in WESTERN NEW YORK

The plant shown above is a new steam-electric generating station at Dunkirk, N. Y., built by the Niagara Mohawk Power Corporation to supplement its other facilities for furnishing electric power to the Western New York area.

The Dunkirk Steam-Electric Station is one of 81 hydro- and 6 steam-electric stations comprising the Niagara Mohawk System, and is the most modern generating station ever constructed. The installed capacity of the station is 160,000 kw, and this can be increased to 320,000 kw should the need arise. The station's turbine generator is new in design, and is the first of its type to be manufactured.

The Dunkirk Station has two 60-cycle, steam-electric generating units, each with a rated capacity of 80,000 kw. Its coal-fired steam generators supply steam at 1450 lb and 1000 F to the turbines, each of which is connected to a 60-cycle, 13,800-volt generator with transformers, to deliver power to the 115,000-volt transmission system.

The 5147 tons of steel in the framework and boiler supports of the Dunkirk Steam-Electric Station was fabricated and erected by Bethlehem.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

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BETHLEHEM STEEL

NEWS BRIEFS . . .

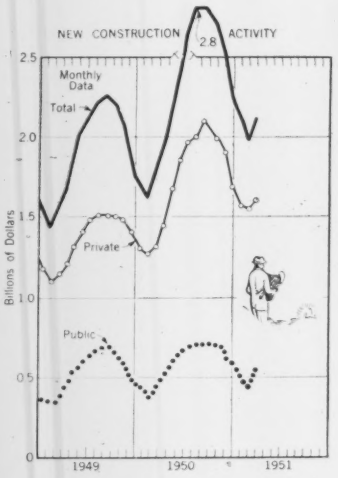
Construction for First Quarter Tops All Records

Construction activity rose seasonally in March to round out the largest first-quarter volume of new construction on record, according to the Building Materials Division of the U.S. Department of Commerce and the Labor Department's Bureau of Labor Statistics. The total value of new construction put in place during the month was estimated at $2.1 billion, 10 percent above the February estimate and 21 percent more than the total for March 1950.

The total value of private residential building activity during the month rose slightly to $848 million, an advance of 14 percent over the corresponding figure for March 1950 when the present housing boom was in its early stages. Further expansion of industrial and commercial building activity in March is also reported. The dollar value of industrial building was double that of a year ago. Public utilities expanded their construction operations seasonally, and there were also increases in highway and construction work conducted by public agencies.

A summary for the first quarter of 1951 placed the total value of new construction work at 6.1 billion, 21 percent above the total for the first quarter of 1950 and the largest first quarter total on record.

During this quarter construction of nearly all types of facilities was carried on at a higher rate than in the corresponding period last year, with the largest increases going for industrial and commercial buildings and for military and naval facilities. Total private outlays for new construction during the period amounted to about 4.7 billion, an increase of 20 percent over last year. Public expenditures of about $1.5 billion were 22 percent greater than during the first quarter of 1950.



RISE IN CONSTRUCTION ACTIVITY in March, shown in Department of Commerce curves, represents increase of 21 percent above March 1950 total.

Production Controls Begin to Affect Construction Volume

The expected squeeze in construction has started, according to Thomas S. Holden, president of the F. W. Dodge Corp., fact-finding organization for the construction industry. Interpreting the organization's estimate of construction contract awards in March for the 37 states east of the Rockies, Mr. Holden predicts that the expected squeeze is likely to continue during the remainder of the year, though the tremendous volume of construction earlier in the year will help offset the later squeeze. Despite an estimated decline in 1951 from 1950, Mr. Holden still believes that 1951 will be a high-volume year for construction.

Citing the March construction figure for the 37 states ($1,267,450,000) as the "second highest March total on record," Mr. Holden said that it, none the less, shows "the restrictive effects of defense rules and regulations. March was the first month since July 1949 that failed to show a contract volume increase over the corresponding month of the preceding year."

Recreational project starts ran behind last year all through the first quarter of 1951, and commercial building projects fell off significantly in March. These trends resulted from the NPA's M-4 order, according to Mr. Holden. In March, he said, "the effects of Regulation X were seen in residential building contract volume just equal to March 1950. The March 1951 residential total was $574,569,000. The March total for 1950 was $574,681,000. This followed January and February volumes that were considerably larger than those of January and February 1950.

"Factors offsetting these declining tendencies in commercial, recreational, and residential building have been large increases in military construction and industrial and power plant projects," Mr. Holden stated.

Boston Firm Receives TVA Steam Power Contract

The Boston consulting firm of Chas. T. Main, Inc., has been selected by the Tennessee Valley Authority to design the foundation and intake structure for one of the world's largest steam power plants. To be built on the Ohio River near Paducah, Ky., the plant will have an ultimate capacity of more than 1,000,000 kw produced by eight 150,000-kva turbo-generators. Eight boilers with a total steam-generating capacity of 8,000,000 lb per hr will be installed. The first TVA steam unit, the new project will supplement the supply of low-cost power in the region.

Battery Park Underpass Is Opened to Traffic

An important link in the projected express route between the West Side Highway and Franklin D. Roosevelt Drive along the East River in New York was completed early in April, with the opening to traffic of twin vehicular tunnels under Battery Park. Built at a cost of about $10,000,000, the underpass and its approach ramps are 3,200 ft long. Special features are an automatic ventilating system, an automatic car counter, and a drainage system. Work on the project, which was begun early in 1949, involved many difficulties because of the proximity of the Brooklyn-Battery Tunnel and three subway lines. In addition, the soil in the area is completely saturated by tidal seepage requiring that the structure be completely surrounded by an envelope of waterproofing. Construction of the project was described in an article by Joseph Metzler (CIVIL ENGINEERING, July 1950).

The final phase of the project to link the East and West Side Express Highways will be started this spring, with the laying of foundations for a 1½-mile elevated highway from Coenties slip to Jackson Street, the present terminus of the Franklin D. Roosevelt Drive.

AEC Plant Facilities Get Advance Planning Funds

Approval of interest-free funds to expedite the preparation of plans for two public works projects made necessary by an anticipated influx of workers in the Atomic Energy Plant reservation area on the Savannah River is announced by the Housing and Home Finance Agency. An advance of $17,120 will go for a $498,900 addition to the water-works system of North Augusta, S.C., consisting of a new supply development, filtration, storage facilities, and distribution lines. Barnwell, S.C., will receive $11,760 to assist in preparing plans for an elementary-high school to cost an estimated $313,640. In both towns existing facilities are inadequate to serve even the present population.

Patchen & Zimmerman, of Augusta, Ga., are engineers for the water-works project, and Hopkins, Baker & Gill, of Florence, S.C., architects on the school building.

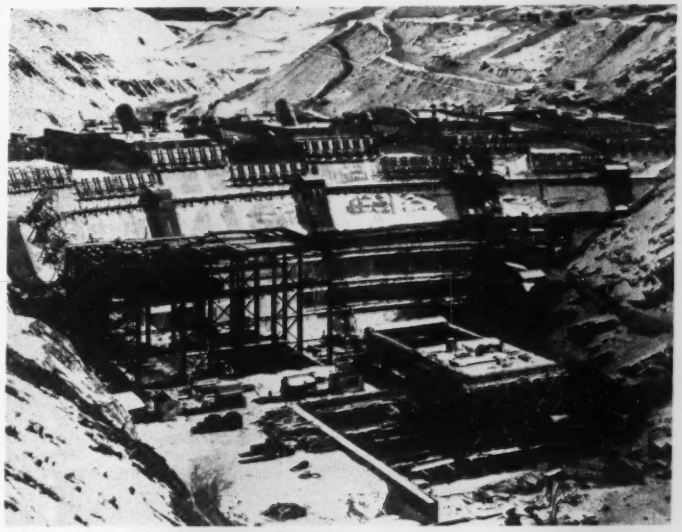
Supreme Court Upholds Ohio River Basin Compact

Powerful impetus has been given the cause of interstate compacts for solution of the problems involved in controlling the use or contamination of the waters in interstate streams by a recent unanimous decision of the United States Supreme Court in ruling that West Virginia continue as a member of the eight-state Ohio River Valley Water Sanitation Commission. Firmly establishing the Ohio River compact as a workable method of interstate cooperation, the Supreme Court decision reverses action of the Supreme Court of Appeals of West Virginia in declaring the state's participation in the compact unconstitutional. In binding West Virginia to the compact, the Supreme Court held that the West Virginia legislature had the power to make a "reasonable and carefully limited delegation of power to an interstate agency."

Justice Felix Frankfurter, in delivering the ruling, said that "a state cannot be its ultimate judge in a controversy with a sister state." The compact, he continued, "involves a reasonable and carefully limited delegation of power to an interstate agency. It evidently was drawn with great care to meet the problem of debt limitation. . . Adjudication here of conflicting state interests affecting stream pollution does not rest upon the law of a particular state."

Henry Ward, chairman of the Commission, states that the court's decision "paves the way for more effective cooperation among the states to control pollution and guarantees that the Commission has power in its own right to act on any interstate problem which the individual states cannot control through their own agencies."

New Contract to Complete Hungry Horse Dam



INSTALLATION OF FOUR 105,000-hp turbines at Hungry Horse Dam in northwestern Montana will be started this spring under new contract, on which Bureau of Reclamation has received bids. Apparent low bid of $1,796,542.30 was submitted by Grafe, Shirley, Lane Co., of Los Angeles. Prime contract for the big multiple-purpose dam and power plant is held jointly by twelve large construction firms, known as General-Shea-Morrison, for $43,000,000, largest single construction contract of Bureau of Reclamation now in force. Major work scheduled this year includes placement of approximately 1,200,000 cu yd of concrete and construction of 285,000-kw powerhouse. Project was begun in June 1948 and is scheduled for completion in November 1953. Photo courtesy of Bureau of Reclamation.

New Registration Legislation in New York State Reviewed

Three amendments to the Engineers Registration Law in New York State have already been enacted in 1951. These amendments are:

1. The section permitting registration (without examination) of engineers registered in other states has been amplified and extended by addition of the sentence, "The department on the recommendation of the board may also credit, toward meeting the examination requirements in this state, the whole or a part of the requirement of another state met by the applicant, provided the requirement in such state or territory was substantially the same as in this state." This amendment enables the New York State Board to accept the examinations passed by Engineers-in-Training in other states, so that they may be certified as Engineers-in-Training in New York State without reexamination. It also legalizes the past informal authorization of the State Board to accept examinations passed in other states as a basis for waiving all or part of the prescribed Professional Engineer examinations in New York State.

2. The section requiring licensed Professional Engineers and Land Surveyors to register with the County Clerk has been repealed. The same amendment repealed this requirement simultaneously for most of the professions. One effect of the repeal of the amendment is that non-residents licensed in New York State may henceforth complete their registration and be listed in the roster without the embarrassment or expense of establishing an office address in the state.

3. The section enacted in 1935 to curb corporate practice of engineering was amended in 1951 by the addition of a sentence permitting corporations formed under certain conditions subsequent to 1935 to practice engineering. This amendment was passed by the legislature before the profession was aware of it, and then signed by the governor despite the vigorous protests of architects and engineers.

These data on recent registration legislation were supplied by D. B. Steinman, M. ASCE, member of the New York State Board of Examiners of Professional Engineers.

Hydroelectric Construction Continues Active in Canada

The postwar boom in hydroelectric development in Canada continued without abatement in 1950, according to the annual review of the water-power resources of Canada issued by the Water Resources Division of the Canadian Department of Resources and Development. Installed capacity during the year was increased by 962,275 hp, an amount exceeded only in the war year of 1943 when the huge Shipshaw Plant was completed. A large proportion of this new capacity is located in Ontario and represents the culmination of the postwar construction program undertaken by the Hydroelectric Power Commission of Ontario.

Other new plants and extensions under active construction are tentatively rated at 1,000,000 hp, and those under preliminary construction or definitely planned at about 1,500,000 hp. Although the demand for hydroelectric energy continued to grow during 1950, power production was in general keeping pace with the increased demand and construction was active in the fields of transmission and distribution.

Newark Truck Terminal Is Leased to Air Force

Leasing of the Newark Union Truck Terminal and open area at Newark Airport to the U. S. Air Force in connection with the government's Mutual Defense Assistance Program is announced by the Port of New York Authority. Annual rent for the use of the $9,000,000 truck terminal, the largest in the world, will be $421,754. Built by the Port Authority for use as a consolidating and transfer terminal for over-the-road truck freight, the terminal was completed last July.

Pennsylvania Pushes Its Stream-Cleaning Program

Wide progress in clearing Pennsylvania streams of sewage pollution is reported by the Bureau of Engineering of the State Department of Health in a recent issue of the department's quarterly publication, *Clean Streams*. Sewage-treatment projects installed since inception of the state's Clean Streams Program are said to represent an expenditure of at least $40,000,000 including an approximate $27,000,000 spent by Philadelphia.

Municipalities throughout the state currently have under construction clean-up projects totaling about $22,000,000. Included in this figure is work now under contract by Philadelphia, which is engaged in a $60,000,000 pollution-abatement program to be completed in 1953. The $11,000,000 Northeast sewage-treatment works there was recently placed in operation, and construction of the Southeast works is well advanced. Work also has been started on the Southwest treatment works and on the building of huge interceptors. Completion of the three plants will eliminate sewage pollution from the entire metropolitan area.

More than $4,000,000 is being spent by Bethlehem, Pa., on construction of sewers, interceptors, and a treatment plant, which will contribute greatly to the cleanup of the Delaware watershed. Two sewage-treatment plants will be built at Altoona to replace the present inadequate treatment works, and the first stage of this cleanup program is under way with contracts amounting to $1,400,000. New Cumberland has awarded contracts totaling $1,127,180 for the construction of sewers, interceptors, and a treatment plant, and Norristown is spending $1,350,000 for additions to its existing works.

Progress comparable to that being made in abatement of sewage pollution is also reported on the industrial front, with installation of treatment works under way in all types of industrial plants.

Good Roads Held Vital to Defense at ARBA Meeting

Intelligent federal leadership for "defense measures that will not permit highway transportation to deteriorate in any degree" was called for by Senator Dennis Chavez, chairman of the Senate Committee on Public Works, in a leading talk at the recent 48th annual meeting of the American Road Builders Association in Milwaukee, Wis. Addressing a defense conference that highlighted the three-day program, Senator Chavez emphasized the fact that "The main highways are the assembly lines of a large portion of our defense plants."

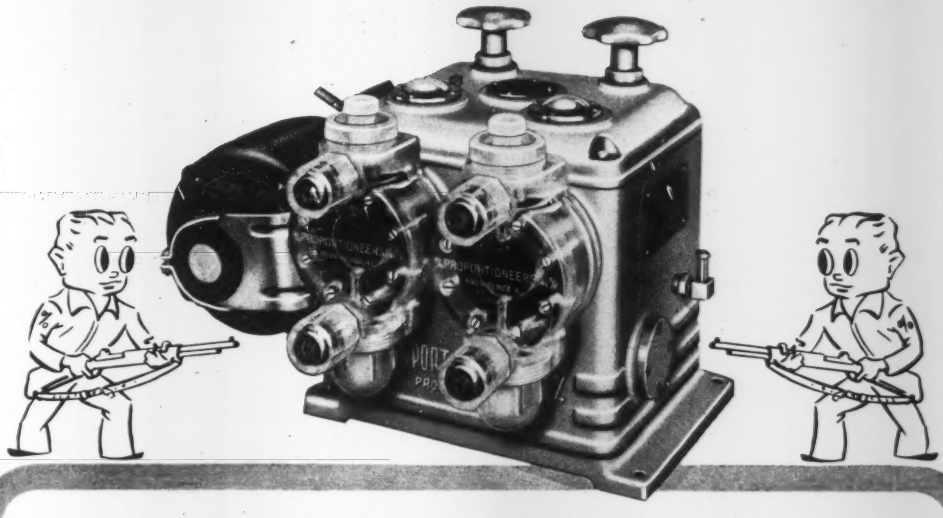
Senator Chavez advocated that the Bureau of Public Roads help determine allocation of materials which, he warned, will be scarce especially in the early days of the national emergency. The Bureau "could set up criteria and the states then could plan and build with a solid program and real knowledge," he asserted.

Referring to current shortages of steel and aluminum, Senator Chavez expressed the opinion that ". . . in another twelve months we will reach a balance on steel and several other items. . . In two years, at the present rate of defense preparedness and in view of the ceilings placed on military personnel and equipment, our increased production will not only carry the defense equipment, but will also come back to near present-day levels on materials."

Other speakers on the program who stressed the vital importance of proper maintenance of existing highways and adequate construction of new roads included ASCE members E. R. Needles, New York consultant and retiring president of the ARBA; Lt. Gen. Eugene Reybold, retired chief of the Army Corps of Engineers and executive vice-president of ARBA; and Gen. James A. Anderson, chairman of the Virginia highway Department and president of the American Association of State Highway Officials. City-to-airport expressways, to effectuate time savings and to facilitate evacuation of the wounded from metropolitan centers in event of enemy attack, were advocated by Walter R. Macatee, highway transportation specialist of the Civil Aeronautics Administration.

Results of a letter ballot of the membership for election of new officers were announced to the attendance of about 1,000. Paul B. Reinhold, president of the Atlas Equipment Corp., Pittsburgh, succeeds E. R. Needles as president. District vice-presidents include Charles M. Noble, M. ASCE, chief engineer of the New Jersey Turnpike Authority, Trenton, and Prof. A. Diefendorf, M. ASCE, head, civil engineering department, University of Utah.

AIRPORTS AND AIRWAYS PLANNING COMMITTEE of ASCE Air Transport Division meets in conjunction with ARBA annual meeting in Milwaukee. Shown, left to right, are Joseph D. Blatt, chief, Planning Staff Division, Office of Federal Airways, Civil Aeronautics Administration, Washington, D. C.; B. Everett Beavin, airport engineer, J. E. Greiner Co., Baltimore, Md.; William C. Hill, chairman of Airports and Airways Planning Committee, and airport engineer, Oregon State Board of Aeronautics, Salem, Oreg.; William M. Beadie, aviation consultant, Minneapolis, Minn.; and Frank B. Brady, Air Transportation Traffic Control Group, Air Transport Association, Washington, D.C.



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Large Pier Increases Philadelphia's Cargo-Handling Capacity

PHILADELPHIA OPENS MUNICIPAL PIER 80 which was recently completed at cost of $5,500,000. Measuring 300 x 1,000 ft, two-story structure is biggest of Philadelphia's 14 piers and will permit city to handle largest cargo ships in service. It has facilities for handling four ships simultaneously. Basic construction is of steel, with use of wrought iron where there is danger of corrosion. Located on the Delaware River at the foot of Jackson Street, structure was designed by Philadelphia Department of Wharves, Docks and Ferries under supervision of Thomas C. Brown, chief engineer.

City Building in 1950 Said to Top All Records

City building activity in 1950 was at its highest dollar level in history, according to preliminary estimates of the U.S. Labor Department's Bureau of Labor Statistics. On the basis of building permits issued and federal contracts awarded, urban building was valued at $10.4 billion, a 40 percent increase over valuations reported in 1949. Housing accounted for most of the gain, although all major types of building construction contributed to the record.

Building permits were issued during the year for $6.2 billion worth of all kinds of residential building and for over 830,000 new dwelling units—75 percent of them single-family homes. These represent a rise of more than 50 percent over the 1949 volume, compared with the relatively slight gain of 6 percent in new rental apartments for which permits were issued. Public rental housing (33,000 units) constituted 16 percent of the 206,000 city apartments authorized in 1950. Although practically all cities reported a rise in the permit volume of single-family houses last year, many reported less rental housing. Among these were New York City, Los Angeles, San Francisco, Seattle, and Washington, D.C.

All regions are reported to have scored increases in urban building valuations during the year, the East North Central region (Illinois, Indiana, Michigan, Ohio, and Wisconsin) leading with valuations totaling 2.3 billion and the Middle Atlantic region next with valuations of $1.8 billion. The West South Central region (Arkansas, Louisiana, Oklahoma, and Texas) recorded the highest percentage of increase over 1949—60 percent to 1.2 billion. California, Texas, and New York were the top-ranking states in the order named, and New York City ($423 million) was the leading city. Los Angeles ($407 million), Chicago ($270 million), and Detroit ($209 million) ranked second, third, and fourth, respectively.

North Pacific Division Announces Bid Openings

Several major civil works are slated for bid opening in the late spring and early summer by Corps of Engineers district offices in the North Pacific Division, according to an announcement from Brig. Gen. O. E. Walsh, division engineer at Portland.

The largest project for which bids will be called in the Portland District is the main contract for construction of Big Cliff Dam and powerhouse, three miles downstream from Detroit Dam. The opening date of bids on this dam, which is estimated to cost more than $4,000,000 is June 29. Other Portland District contracts costing over $1,000,000 include manufacture and delivery of three turbines and governors for Lookout Point Dam, bids due on July 6; manufacture and delivery of three generators for Lookout Point Dam, with the same bid date; and construction of the powerhouse superstructure at Detroit Dam, with bids due on June 29.

Large contracts to be let by the Seattle District include works to prevent erosion of Point Chehalis and south jetty at Grays Harbor and Chehalis River, for which bids are due June 7, and supplying Tainter gates for Chief Joseph Dam, with bids to be opened June 12.

Large Aluminum Plant to Be Built in Arkansas

To make more aluminum available for defense needs, the Aluminum Company of America will build a large new alumina plant near Bauxite, Ark., with construction scheduled to start immediately. Designed to process low-grade bauxite ore, the new plant will increase by nearly 50 percent the amount of alumina now being produced by the company. Alumina is the refined ore from which basic aluminum is obtained by the smelting process.

To be operated by the Aluminum Ore Co., a subsidiary of the Aluminum Company of America, the new plant will be located on a 200-acre site adjoining the bauxite mining operations of the Alcoa Mining Co., another Alcoa subsidiary. The entire construction project will be carried out by Alcoa, serving as its own general contractor.

U.S. Contractors Awarded New Zealand Pier Contract

Award of a joint contract to two American and one New Zealand company for construction of a four-berth ocean freight terminal at Auckland, N.Z., is announced by the Auckland Harbour Board.

The Raymond Concrete Pile Co. and Merritt-Chapman & Scott Corp., both with headquarters in New York, will participate in the joint venture contract with the Fletcher Construction Co., Ltd., of Auckland. Their joint competitive bid of £1,854,789 (approximately $5,137,409 at the current rate of exchange) provides for construction of the reinforced concrete substructure and deck of the 1,200 x 300-ft pier, including its rail facilities and inshore steel pile retaining bulkhead. Major items of construction equipment involved in the work, the first large pier construction project undertaken at Auckland since 1939, will be shipped to New Zealand from the United States.

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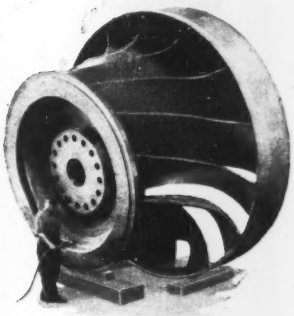
SURGING, irresistible water . . . Sweeping through rapids and roaring over the cataract's crest . . . An inextinguishable source of power — tamed and subjugated in the service of man!

Nothing in the mythical accomplishments of the alchemist of old, who by sorcery changed lead into gold, surpasses in magic the conversion of the power of falling water into electrical energy by Smith-made water power machinery.

More than 75 years, devoted exclusively to the building of hydraulic equipment — including turbines alone of more than 8,000,000 horsepower capacity — are your assurance of maximum power results, when you place your problem in our hands!



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If It's Hydraulics-Put It Up to Us.

POWER by SMITH

Pittsburgh Company to Build Blast Furnace in Brazil

A contract for design, supervision of construction, and initial operation of a large blast furnace and battery of chemical-recovery coke ovens for the Brazilian National Steel Co. at Volta Redonda, Brazil, has been given to Koppers Co., Inc., of Pittsburgh.

Work on the new 25-ft hearth diameter blast furnace, which will double the potential pig iron capacity of the Brazilian plant, will be handled by the Koppers Freyn Engineering Department, with offices in Chicago. The battery of 21 under-jet coke ovens, which may be underfired with coke oven, blast furnace, or producer gas, will increase the carbonizing capacity of the plant from 1,600 to 2,212 tons a day. Changes will also be made in the coal chemicals plant to accommodate additional capacity from the new ovens.

The Koppers Co. completed the original battery of 55 ovens and the coal chemicals plant at Volta Redonda, one of the largest steel plants in South America, in April 1946.

Structural Steel Scholarships Are Announced by AISC

To encourage future engineers to enter the fabricated structural steel industry, the American Institute of Steel Construction will make available ten scholarships of $1,000 each in technical schools and colleges during 1951. Although the objective of the program is to train engineers and administrators for the industry, recipients of the scholarships are under no obligation to continue in the industry after graduation.

Scholarships are available only to students who pursue the full civil engineering course offered at one of the 125 colleges on the ECPD accredited list. Full details are available from the Committee for Education of the American Institute for Steel Construction, Inc., 101 Park Avenue, New York 17, N.Y.

Army Engineers Open Bids for McNary Dam Completion

Bid openings for completion of McNary Dam on the Columbia River, largest single civil works contract ever advertised by the Corps of Engineers, disclose an apparent low bid of $58,416,459, according to an announcement from Maj. Gen. Lewis A. Pick, M. ASCE, Chief of Engineers. The bid was submitted in a joint venture by the Guy F. Atkinson Co. of San Francisco; the Ostrander Construction Co. of Portland, Oreg.; and the J. A. Jones Construction Co. of Charlotte, N.C.

Begun in 1948, the McNary Project is now about 40 percent done. Remaining work includes completion of the dam, spillway, powerhouse, and appurtenant structures. The project will have a powerhouse installed capacity of 980,000 kw, and will provide 67 miles of slackwater navigation on the Columbia and lower Snake rivers. Initial power generation from the project is scheduled for December 1953.

More Scrap Held Vital to High Steel Output

Urgent need for steel scrap to maintain the present high productive capacity of the industry is reported by the Committee on Iron and Steel Scrap of the American Iron and Steel Institute. Pointing out that at the end of 1950 the national inventory of scrap in the hands of producers and consumers was being depleted, the committee states that a continuance of that trend will adversely affect steel production. The scrap requirement of the industry for 1950 totaled more than 54,000,000 tons, and the anticipated increase in productive capacity will increase the average annual scrap requirement an additional 5,000,000 to 7,000,000 tons by the end of 1952.

All scrap lying unused should be turned over immediately to dealers in scrap, the committee emphasizes. Likely sources of supply are industrial plants, automobile graveyards, railroad yards, and farms.

Pollution Control Is Responsibility of Industry

It is industry's responsibility to, "Develop full information about its own waste and take necessary corrective action; educate its own employees; cooperate with municipal officials and with state, interstate, and federal control agencies; and keep the public advised concerning the progress which is being made." This responsibility was outlined by Lyman Cox, chairman of the Water Pollution Abatement Committee of the Manufacturing Chemists Association, at a recent joint session with the MCA's Air Pollution Abatement Committee.

As an example of what can be accomplished, Roy McCracken discussed the progress made at the Waynesboro, Va., plant of the Du Pont Co., where 75 percent of the waste discharged into the South River has been eliminated without treatment works. This saving was achieved "through the cooperation of management, technology, maintenance, operating personnel, and an expenditure of half a million dollars," he stated.

In a dinner address before the joint committees, Edward Cleary, M. ASCE, executive director and chief engineer of the Ohio River Valley Water Sanitation Commission, discussed the Commission's work and the Supreme Court decision of April 10, 1951, which states that the delegation by a state, of police power (authority) to an interstate agency for the regulation of waste discharges was reasonable and legitimate. This decision is discussed on page 69 of this issue.

Huge Box Girder Erected for Passaic River Bridge

ERECTION OF steel box girder at south approach of Passaic River Bridge advances construction of New Jersey Turnpike. Here workmen for Bethlehem Steel Co., contractor on fabricated steel superstructure, direct placing of girder over freight line of Pennsylvania Railroad. This girder, 95 ft long and weighing over 100 tons, will support main longitudinal bridge girders. Ammann & Whitney, New York, are designers and supervisors of construction of bridge for New Jersey Turnpike Authority.

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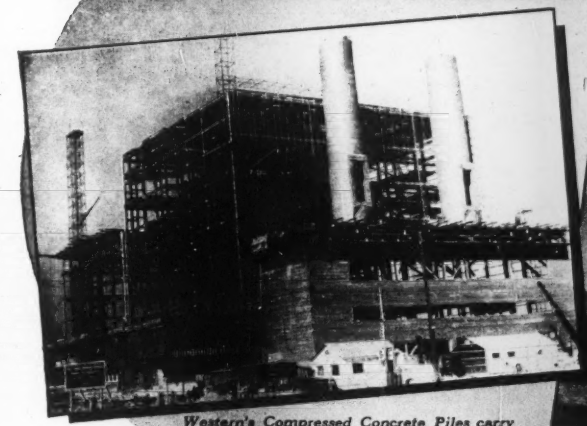
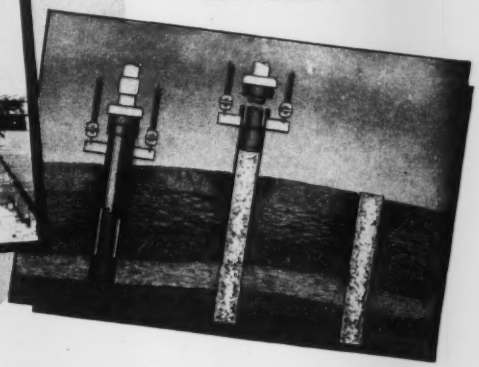


Western's Compressed Concrete Piles carry Toronto's first major Steam-Electric Plant.



WESTERN COMPRESSED CONCRETE PILES require no encasement; they are available immediately despite steel shortages. Their exceptional carrying capacity and economy have led to their use throughout the country in soils firm enough to act as a form for the concrete.

TYPICAL COMPRESSED CONCRETE PILE JOBS:

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Toronto, Ontario	Liquor Control Board Building
South Amboy, New Jersey	Steam-Electric Power Plant
Norfolk, Virginia	DePaul Hospital
Tallahassee, Fla.	W. T. Edwards Tuberculosis Hospital
Knights Landing, California	Grain Elevator

WESTERN engineers are available at any time to discuss your foundation problems and offer expert advice. Write for illustrated brochure describing in detail Western Piles and service.

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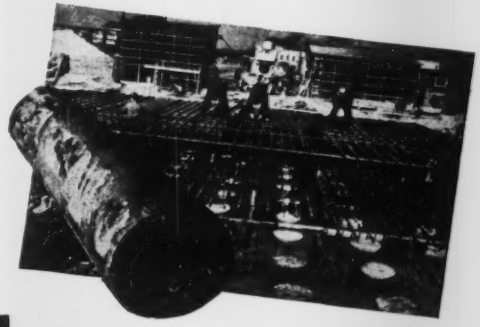
SEE OUR CATALOG IN SWEET'S

The drive-tube and close-fitting core are driven to a required depth. The core is removed and the tube filled with concrete. Then the core is replaced on the concrete and the tube pulled by Western's positive method of automatically depositing concrete so as to prevent separation and assure a shaft of constant diameter, greater at all points than the diameter of the forming tube.



More than 2,000 Western Compressed Concrete Piles support the Richard L. Hearn Steam-Electric Generating Plant at Toronto. Inset is a pile pulled after being formed against soil compacted by driving. Note the constant diameter and smooth surface.

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Neare's N. G. COLUMN

R. Robinson Rowe, M. ASCE

"I deplore canasta, Professor," said Joe Kerr, "but the idea of an automatic shuffler intrigued me. I bought one of those mixer-uppers you told about last March."

"Just to work the problem?" asked Professor Neare.

"No, just to stir up a flinch deck. It doesn't take two cards from the right and one from the left like yours, so I had to use another method. I took 108 blank cards and numbered them in order from top to bottom. Simulating your mixer-upper, I put the 1–72 cut to the right and the 73–108 cut to the left, lifted the decks in my respective hands, then dropped two cards from the right, then one from the left, and so on. The new order was then: 73, 1, 2, 74, 3, 4, . . . 108, 71, 72.

"Every card being in a new place, it follows that each will occupy all the places in turn and return to its original place on the 108th shuffle. Suspecting one of your tricks, I thot maybe there were several groups of cards each making shorter cycles which were factors of 108, so I followed the top card thru its consecutive positions, 1, 2, 3, 5, 8, 12, etc., to 95 on the 54th shuffle. This 54 being the largest factor of 108, all answers except 108 were eliminated."

"Joe was warm," interposed Cal Klater, "but he didn't get hot. Had he gone on to the 80th shuffle, 88 cards including the top card would have been back in place. Had he looked after the 42nd shuffle, he would have found the other 20 cards in place. After 1,680 shuffles, the 80-cycle and 42-cycle series would be in phase and all cards would be in place. Really, there are repeating series of 80, 14, 6 and 8 cards beginning with cards 1, 16, 19 and 31, and 1,680 is the LCM. I suppose there is some general rule; if N is the number of shuffles for $3n$ cards, we have here $n = 2 \cdot 2 \cdot 3 \cdot 3$ and $N = (2 + 2 + 3)!/3$."

"Maybe," admitted the Professor, "because for $n = 7 + 6$, $N = 7!/6$, but $N = 7!/6$, but $N = 20000\pi$ for $n = 30$ and Joe's method would have worked for $n = 1, 3, 5$ or 27. It's odd too that for $n = 1, 4, 5, 6, 8, 12$ and 14, N is the triangular number corresponding to 2, 4, 5, 7, 6, 14 and 8. Even for Joe's flinch deck, $n = 50$ and $N = 152{,}490$, which is twice a triangular number.

"This suggests a diverting sequel, but maybe we can make it more diverting if we discard the canasta deck and conjure up 108 girls playing leapfrog. If you like figures, let them wear play suits. If they started in one long column, 108 sorties of last girl to first place would restore the order. If in four parallel columns of 6, 8, 14 and 80 girls respectively, it would take 1,680 sorties, just as in our shuffling problem. If in 54 columns of two, the two sorties would be a minimum. How would you arrange the girls for a maximum?"

[Cal Klaters, most of whom wanted it thoroly understood that they deplored canasta as much as Joe, were: R. E. Philleo, Flo Ridan (Charles G. Edson), Julian Hinds, Sauer Doe (Marvin Larson), James R. Bole and Richard Jenney. Answering some, if the deck consists of two identical 54-card decks, 40 sets of twins can be spotted in the deck so that there is an apparent restoration of order after 840 shuffles. Also acknowledged is Paul J. Foehl's solution of the Ozian Tream problem; he just missed an early deadline.]

Need for Treatment Projects in Tennessee Valley Cited

Sewage and waste-treatment projects costing upwards of $57,000,000 are needed at 227 municipal and industrial locations in the Tennessee River Valley to control water pollution in an area covering portions of seven states. This recommendation is contained in the first of a series of summary reports on the major drainage basin areas of the country, which are being prepared by the Public Health Service, in cooperation with the states, under authority of the Water Pollution Control Act of 1948.

The Tennessee River Basin report has just been released by the Public Health Service. Others in the series, dealing with 14 other major river basins of the country, are nearing completion and will be issued as finished. Inquiries concerning the present report, which is designated Public Health Service Publication No. 69, should be addressed to the Public Health Service, Federal Security Agency, Washington, D.C.

Asphalt Research Center Established

Formation of a National Asphalt Research Center to serve the asphalt industry in the United States is announced by the Franklin Institute Laboratories for Research and Development. With 21 sponsoring industrial organizations, the center will study the fundamental properties of asphalt and seek practical ways of using such knowledge to develop improved products and new markets. Its major work during the first year will be to devise practical and scientifically correct methods for measuring the four basic properties of asphalt—elasticity, plasticity, viscosity, and adhesion to solid surfaces at various temperatures and rates of shear.

Postwar Civil Engineering Curricula Are Analyzed

To meet the need for a detailed analysis of civil engineering curricula, G. R. Swihart, Jun. M. ASCE, and J. J. Hromadik, of the Department of Civil Engineering at the University of Nebraska, have analyzed 111 such curricula and reported the results. They note that the 1944 and 1945 reports of the ASCE Committee on Engineering Education (PROCEEDINGS for March 1946) provided an analysis of the curricula of 114 schools offering civil engineering, resulting in a suggested allocation of time to seven different subject groups. These subject groups included civil engineering, to which 30 percent of the total time was allocated. However, there has been no detailed analysis of curricula with respect to civil engineering subjects themselves.

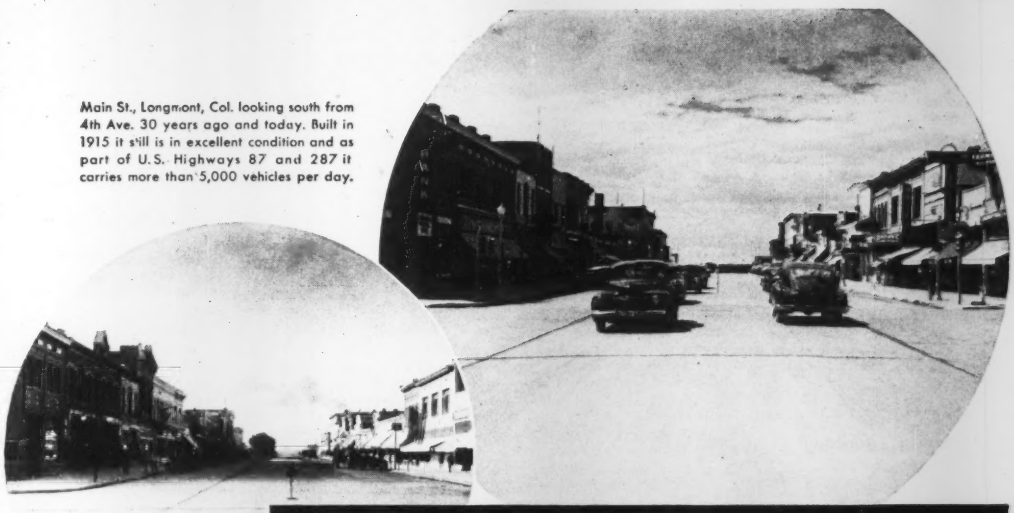
Only schools with four-year curricula are included in the present analysis. Data were taken for the major divisions used by the Society's Committee for the entire curriculum, to determine if there were significant differences between the 114 schools studied in the 1944 report of the Committee on Engineering Education and the 111 schools analyzed in the present report. No significant differences were apparent, and it is believed that the 111 schools currently analyzed are statistically the same as those reported by the ASCE Committee.

The present analysis shows that 60 percent or more of the 111 engineering schools require the subject groups indicated in the accompanying tabulation.

Subject Group	Percentage of Schools Requiring	Median Percentage of CE Hours
Determinate Structures	100	30
Surveying, other than summer	96	17
Highway, Transportation, etc	94	6 5
Public Water Supply	76	4 5
Contracts, Specifications, etc.	67	3 6
Sewerage	63	3 3
Indeterminate Structures	61	3 9

Regional influences were found to affect the percentages of time devoted in the curricula to the last four subjects listed in the table. Fewer schools in the far east, the far west, and some southern areas require these courses in their four-year curricula, although they are available as electives. Hours devoted to the first three courses listed show no regional trend.

The full report is available on request from the authors or Prof. George C. Ernst, chairman of the Civil Engineering Department, University of Nebraska, Lincoln 8, Nebr.



Main St., Longmont, Col. looking south from 4th Ave. 30 years ago and today. Built in 1915 it still is in excellent condition and as part of U.S. Highways 87 and 287 it carries more than 5,000 vehicles per day.

A short story about long service— *CONCRETE STREETS* in Longmont, Col.

LONGMONT, Col. paved its first street with concrete in 1915. By 1923 it had 105,000 sq. yd. of concrete in service on its busiest streets.

Angus E. Slee, City Engineer of Longmont for 14 years, has this to say: "After 28 to 35 years of service, this paving is in excellent condition. Practically the only maintenance that has been required has been the filling of expansion joints with tar every two or three years. A conservative estimate of the probable life of this paving would be another 70 years."

"This contrasts very sharply with our experience with a lower type of paving placed in residential districts commencing in 1933. While lower in first cost, this paving has to be replaced completely every two to three years. We have spent enough on maintenance and replacement of this type of surface to have put in portland cement concrete paving, and our residential streets are still a constant source of expense and complaints."

Other city officials all over America also have learned that concrete pavement lasts longer and needs less maintenance. They have discovered too that concrete pavement usually costs less to build than any other pavement of equal load-carrying capacity and that in the long run all these factors add up to ***low annual cost,*** making concrete the best pavement buy for any city.

For more information write for a free copy of the 112-page booklet, "*Concrete Pavement Design.*" Distributed only in the United States and Canada.

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A national organization to improve and extend the uses of portland cement and concrete . . . through scientific research and engineering field work

Left: 4th Ave., looking east from Bross St. Built in 1916 it still is giving dependable service today.

•

Right: 5th Ave., looking east from Gay St. Built in 1919, this pavement is in good condition after rendering over 30 years of uninterrupted service.

NEW IN EDUCATION

As part of Stevens Institute's long-range program to help improve municipal administration in New Jersey, it has been engaged by the Bergen County Planning Board of Freeholders to make a survey of refuse and garbage disposal systems in 70 towns in the county. The project will be headed by Paul A. Volcker, retired municipal manager of Teaneck, and William S. Foster, Assoc. M. ASCE, editor of *The American City*.

To provide top priority on scientific work for the nation's armed forces, Southwest Research Institute has created a Division of Military Research and Development designed to expedite all governmental and industrial projects geared to the defense effort. The services and facilities of the 150-man staff, fully equipped laboratories, and 4,000 acres of test area are being offered to the government.

Over 25 percent of the alumni members replying to a questionnaire sent out by the New York University College of Engineering in a recent survey, are employed in important non-engineering posts, according to an announcement from Dean Thorndike Saville, M. ASCE. Conducted during the past two years to gather data for a new directory, the poll shows that many of the engineering alumni hold executive positions in other fields—172 are teachers, 159 are salesmen, 67 are Army and Navy officers, 66 are meteorologists, 45 are lawyers, 14 are medical doctors, and 7 are physicists. A group of 95 are occupied in miscellaneous fields, working as statisticians, publishers, editors, purchasing agents, architects, or are in business for themselves. These results according to Dean Saville indicate the value of engineering training as a preliminary to entering many fields of responsibility. He pointed out that one surgeon took engineering as a pre-medical course because it taught the principles of three dimensional and structural analysis which are vitally important in surgery.

The St. Anthony Falls Hydraulic Laboratory of the University of Minnesota announces the availability of graduate research assistantships in the field of theoretical and applied hydraulics and fluid mechanics for the academic year 1951-1952. Open to qualified graduate students, the assistantships carry a stipend of $112 per month, plus tuition exemption. A limited number of full-time positions as research fellow, with a starting salary of $330 per month, are also available. Additional information and application forms may be obtained from Dr. Lorenz G. Straub, Director, St. Anthony Falls Hydraulics Laboratory, University of Minnesota, Minneapolis 14, Minn.

A project to consolidate all available information on water-quality standards as an aid to water pollution control agencies is under way at the California Institute of Technology. The work, involving a critical evaluation of thousands of references, is being done under contract with the California State Water Pollution Control Board. According to executive officer, Vinton W. Bacon, Assoc. M. ASCE, the survey has a two-fold purpose—to make the data on water-quality requirements for all beneficial water uses readily available to the state and nine regional boards, and to indicate where more research is needed. Dr. Jack E. McKee, Assoc. M. ASCE, is directing the project for the Institute, with the assistance of Richard H. Gilman, Jun. M. ASCE, project engineer.

To gear its work more closely with defense mobilization, Rensselaer Polytechnic Institute, starting in July, will adopt the year-round quarter system of admitting students four times each year and permitting them to graduate in three years. Those who wish to do so, however, may continue at the normal pace. The Institute wishes to use its full resources in meeting the acute shortage of engineers and scientists. If Congress permits, June high school graduates may enter college in July, begin Reserve Officer Training work and expect to have three years of college to qualify them for special jobs in the Armed Forces or essential industry. Men returning from military service may enter college without long delay.

Graduate courses leading to advanced degrees are being offered by the Illinois Institute of Technology in the following fields, building research, city planning, civil engineering, public engineering administration, and others. Scholarships covering tuition will be available to exceptional students, desiring to devote full time to graduate study. Teaching assistantships and research assistantships are also being given in connection with sponsored research projects in several departments. Further information and applications may be obtained from the Illinois Institute of Technology, Office of Admissions, Graduate School, Technology Center, Chicago, Ill.

University of Florida Is Host to Structural Conference

Welded design and prestressed concrete were the topics of discussion at the recent Second Annual Structural Engineering Conference at the University of Florida. More than 200 attended the two-day conference, which was held as a public service function of the Engineering and Industrial Experiment Station. Frank Bromilow, Assoc. M. ASCE, associate professor of civil engineering at the university, headed the planning committee of technical society representatives organized by the university.

The need for standardization in welded joint details was pointed out by La Motte Grover, M. ASCE, welding engineer for the Air Reduction Sales Co., of New York, in a paper on the "Design of Welded Joints." W. Spraragen reported the structural steel research activities of the Welding Research Council, of which he is director, and described work in progress at various universities and the National Bureau of Standards. In a talk on "Shop and Field Practices in Welding," R. W. Cloues, Assoc. M. ASCE, of the Aetna Steel Co., Jacksonville, noted that the butt-welded joint has possibilities not offered by any standard riveted joint.

The current status of prestressed concrete was reviewed in discussion by D. L. Chaney, of the Portland Cement Association; T. R. Crom, building inspector for the City of Gainesville; and J. N. Hicks, of John A. Roeblings' Sons. A symposium on research in progress at the University of Florida, led by Prof. C. D. Williams, M. ASCE, concluded the technical program.

The work of the ASCE Structural Division was reviewed by J. M. Garrelts, M. ASCE, chairman of the Division and professor of civil engineering at Columbia University, at the dinner meeting. He pointed out that there is need for more scientific training for structural engineers, saying ". . . we should raise our sights in the field of engineering education." He also expressed the opinion that ASCE should take a positive stand in the matter, and that, "The engineering profession should organize a comprehensive program in fundamental research rather than leave this responsibility to the government."

SPEAKERS' TABLE AT DINNER MEETING held during Structural Engineering Conference shows, left to right, Prof. C. D. Williams, W. Spraragen, Mrs. Spraragen, Mrs. W. L. Sawyer, Prof. J. M. Garrelts, Professor Sawyer, D. L. Chaney, D. V. Wilcox, Dr. J. Stuart Johnson, assistant dean of University of Florida College of Engineering, R. W. Cloues, and J. N. Hicks.

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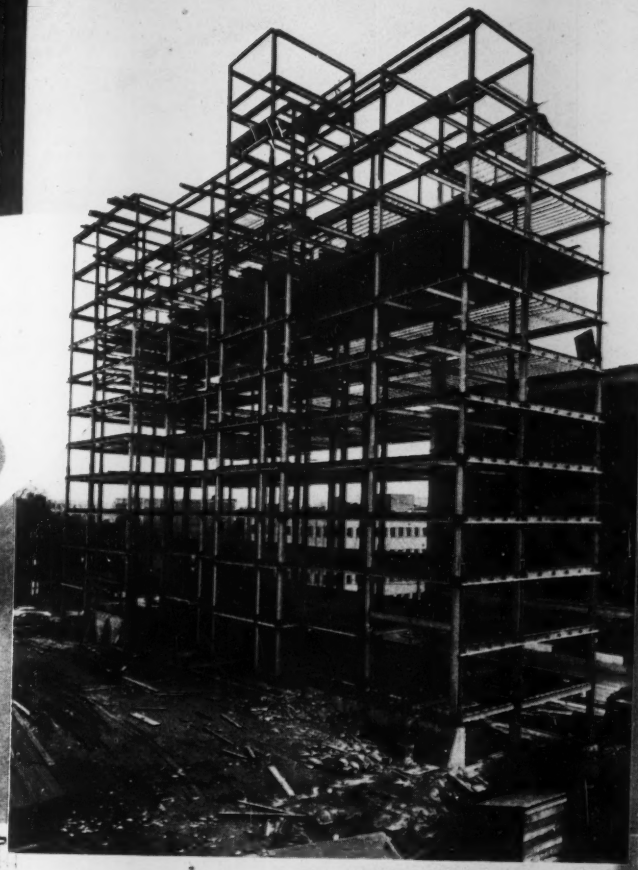

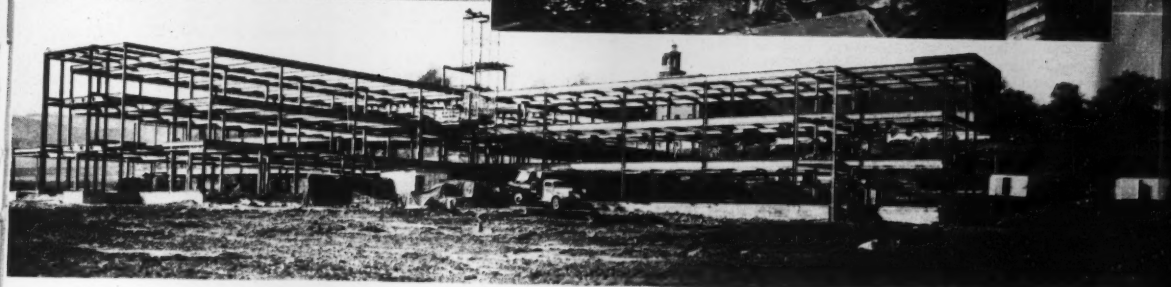

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New in Education

(*Continued from page 78*)

The University of California at Los Angeles is offering Engineering Extension courses in structures, building design and construction, and soil mechanics. A course in elements of community planning covers principles of street and highway traffic engineering, the evaluation of control of atmospheric contaminants, and the fundamentals of subdivision design.

DECEASED

Frank William Allen (Assoc. M. '98) of Watertown, N.Y., died recently. His age was 84. A graduate of Union College, class of 1893, Mr. Allen had been junior engineer for Hoosick Falls, N.Y., and with the New York City park and highway departments. Beginning in 1911, he was engineer for the New York contracting firm of Rodgers & Hagerty.

Charles Stuart Bennett (M. '27) assistant chief engineer of the Miami Conservancy District, at Dayton, Ohio, died on March 10, at the age of 59. Mr. Bennett had been with the engineering division of the district for 33 years. In 1919 he was advanced to engineer in charge of field surveys. Later he supervised the system of flood warning and river stage predictions on the Miami River. He was a Purdue University graduate.

Charles Bradshaw (M. '26) of South Pasadena, Calif., died recently. He was 81. For some time Mr. Bradshaw served the Arrowhead Reservoir Co., at San Bernardino. He became a member of the Los Angeles consulting firm of Salisbury, Bradshaw & Taylor in 1922. His firm's projects included design and construction of the water supply for Beverly Hills and a drainage and irrigation system for the American Beet Sugar Co., at Oxnard.

Morris Colt Burke (M. '44) resident engineer for the consulting firm of Joe E. Ward, at Perrytown, Tex., died recently, at the age of 62. Mr. Burke had been chief engineer for several water and irrigation districts in Texas, Colorado, and Oklahoma, and for a number of years did private consulting work. He was a major in the Corps of Engineers during World War II. He received his engineering training at Epworth University.

Ralph Ernest Campbell (Assoc. M. '28) chief engineer in the engineering office of Clyde C. Kennedy, in San Francisco, Calif., died on February 6. His age was 59. In 1924 Mr. Campbell became connected with Clyde C. Kennedy, serving successively as associate and chief engineer on municipal improvements, including the North Point Sludge Treatment Plant and the Southeast Sewage Treatment Plant in San Francisco. Previously he had acted as assistant chief engineer and assistant to the general manager on oil field development in Colombia, South America. He attended the University of California.

William Henry Code (M. '07) retired engineer of Hollywood, Calif., died on March 28, at the age of 85. He was educated at the University of Michigan. Mr. Code was in the employ of Saginaw, Mich., and the Union Pacific Railroad, and later became chief engineer and superintendent for the Consolidated Canal Co. in Salt River Valley, Ariz. He also served as assistant state engineer of Cheyenne, Wyo., and was chief irrigation engineer for the U.S. Indian Service. For 25 years he was engaged in consulting work as a member of the firm of Quinton, Code, Hill, Leeds & Barnard.

Merrill Bernard (M. '26) chief of the Climatological and Hydrologic Services of the U.S. Weather Bureau, Washington, D.C., died at his home in that city on April 13. Mr. Bernard went to Washington in 1936 as hydraulic engineer for the Soil Conservation Service, and a year later entered the Weather Bureau as chief of its River and Flood Division. He became hydrologic director in 1939 and chief of the Climatological and Hydrological Services in 1946. An internationally recognized authority on climate and hydrology, Mr. Bernard received the Society's Norman Medal in 1946 for a paper on "Primary Role of Meteorology in Flood Flow Estimating." He had served on the ASCE Committee on Hydrology and as chairman of the Research Committee on Precipitation. He held office in many professional societies, and, at his death, was president of the International Union of Geodesy and Geophysics.

Merrill Bernard

Charles A. Mead, Former ASCE Director, Dies

Charles Adriance Mead (M. '04) retired consulting engineer of Upper Montclair, N.J., died on March 28, at the age of 80. Mr. Mead was a graduate of Pratt Institute, where he instructed in mechanics and architecture and lectured in structural engineering. From 1898 to 1907 he was principal assistant engineer and office engineer for Boller & Hodge, New York engineers, and from the latter year to 1940 was chief engineer for the Division of Bridges and Grade Crossings of the New Jersey Railroad Commission and the Public Utilities Commission of the State of New Jersey. He had also worked on varying engineering projects in South and Central America and the Philippines. He was Director of ASCE from 1931 to 1933.

Charles A. Mead

Ralph Justin Fogg (M. '21) business consultant to the U.S. Department of Justice, Washington, D.C., died on March 20. He was 67. A graduate of Tufts College, Mr. Fogg was on the staff of Lehigh University for 21 years. He served as deputy administrator of the National Recovery Administration from 1933 to 1935, and later was director of investigations in the Labor Department's Public Contracts Division. He had been in the Anti-Trust Division of the Justice Department since 1944.

James Zachariah George (M. '11) engineer and analyst of Dallas, Tex., died there on February 27, at the age of 73. An authority in the railroad, power, and municipal engineering fields, Mr. George had been chief engineer for the Northern Construction Co., at Lansing, Mich.; president and chief engineer of the Gas Power Machinery Co., in Cleveland, Ohio; and president and chief engineer of the George Construction Co., engineers and constructors, of Memphis, Ohio.

Lloyd Woolsey Greene (Assoc. M. '11) assistant division engineer for the New York Central Railroad, at Albany, N.Y., died on January 28. His age was 70. In 1905 Mr. Greene joined the staff of the New York Central & Hudson River Railroad Co., serving as rodman, transitman, and assistant engineer of the Ontario Division, Oswego, N.Y. Earlier he was affiliated with F. A. Hinds, Watertown, N.Y., consultant. He received his education at Clarkson College.

Herbert Henderson (M. '17) vice-president of the engineering department of the Gulf Oil Corp., at Pittsburgh, Pa., died on July 7, 1950, though word of his death has just been received at Society Headquarters. He was 67. Mr. Henderson had been with the Pennsylvania Railroad, in Uniontown and Pittsburgh, Pa., and served as a member of the firm of Hindman Henderson Co., construction engineers of Pittsburgh. Subsequently he was engaged by the American Bridge Co. and the Gulf Refining Co.

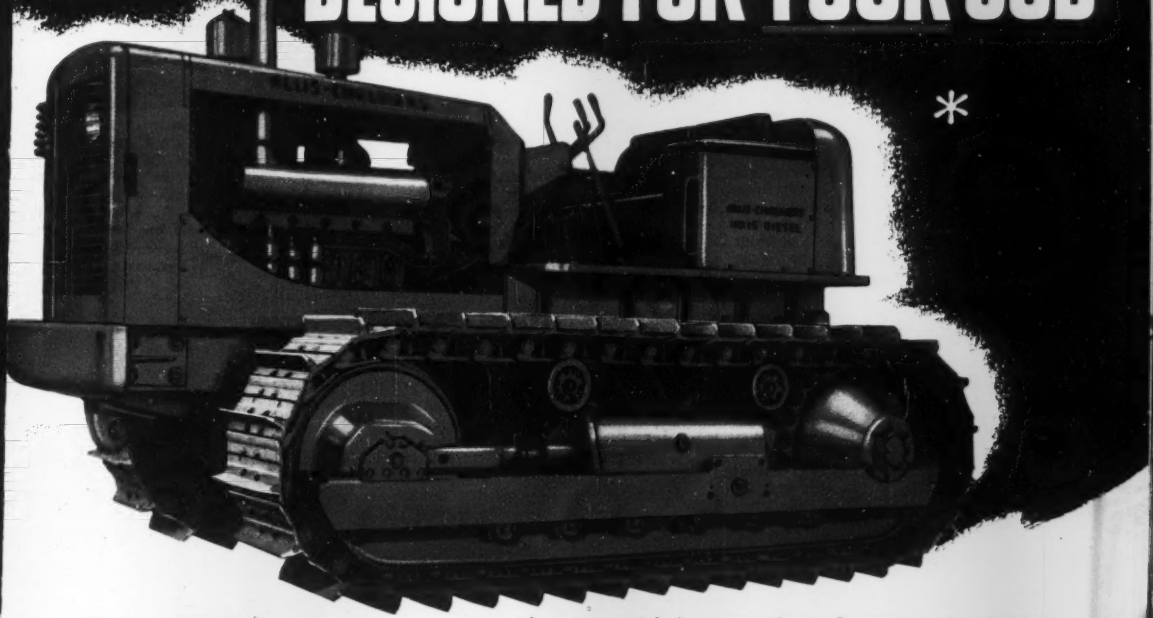
James Rowley Hendry (M. '23) of Fort Worth, Tex., died on February 20, at the age of 68. Upon his graduation from the University of Michigan in 1906, Mr. Hendry entered the employ of the City of Columbus, Ohio. In 1911 he became a member of the Detroit, Mich., City Engineer's staff, serving in various capacities until 1915 when he was made head of the Division of Sewer Design. In the latter capacity, he headed preparation of plans for a $40,000,000 sewer construction program. In 1925 he became principal engineer of the newly organized Detroit Rapid Transit Commission, and later was with the plant engineering department of the Ford Motor Co., participating in organizing the plant for the war effort. He moved to Fort Worth in 1950.

Leon Lynwood Holland (M. '19) retired civil engineer of Wakefield, R.I., died on February 4, at the age of 80. In general

(*Continued on page 82*)

Here's what WE mean by

DESIGNED FOR YOUR JOB



The new Allis-Chalmers tractors are not merely new models incorporating refinements of existing ideas . . . they are new from the ground up . . . without compromise anywhere in design or material.

They are the answer to your demands for tractors that will give you outstanding performance on a variety of applications — whatever those jobs may be.

Behind the design are your own ideas . . . and those of your operators and mechanics . . . combined with the vast experience of Allis-Chalmers.

Check the following outstanding features . . . then get the full story from your Allis-Chalmers dealer on this — "THE FINEST TRACTOR LINE ON EARTH."

POWER TO SPARE — A large untapped reserve (up to 1/3 of peak available hp.) assures easier going on toughest work — longer engine life, less servicing. Moreover, it has been proved that General Motors 2-Cycle Diesels are unmatched in lugging ability; they build up torque faster and higher . . . hold it longer.

MATCHED POWER TRAIN ASSEMBLIES — Each and every part of the power train — from master clutch to final drive — has more than enough capacity and strength to handle any load it was ever meant to carry. Bigger clutches, booster steering, double-reduction final drives, all add life—get more work done.

REVOLUTIONARY SHIFT PATTERN — A quick, one-lever shift from any forward speed to any reverse position saves shifting motion and time — smoother and easier, too.

POSITIVE BALANCE — Tractors work equally well with any equipment — drawn or mounted. There's *greater stability* and *traction* with more track on the ground and lower structural weight. Main and truck frames are heavier, truck frames longer . . . idlers are bigger, and both idlers and sprockets lowered . . . all steel construction throughout. Up to 50 percent more ground clearance!

ALLIS-CHALMERS

TRACTOR DIVISION — MILWAUKEE 1, U. S. A.

The Newest, Finest Tractor Line on Earth!

40.26 drawbar hp.
11,250 lb.

70 drawbar hp.
18,800 lb.

102 drawbar hp.
27,850 lb.

Hydraulic Torque Converter Drive
175 net engine hp.
41,000 lb.

- **DESIGNED FOR YOUR JOB**
- **BUILT TO "TAKE IT"**
- **EASY TO OPERATE**
- **EASY TO SERVICE**

Deceased

(*Continued from page 80*)

practice in Wakefield for many years, Mr. Holland designed wharf, street, and building projects for several Eastern cities. He had also engaged in preliminary construction work for the U.S. Engineer Department on the coast defenses of Narragansett Bay.

Frank Dodge Leffingwell (M. '05) retired engineer of Chula Vista, Calif., died on December 1, 1950, though notice of his death has just reached Society Headquarters. His age was 88. After receiving his degree from the Sheffield Scientific School, Mr. Leffingwell did graduate work there and taught. He served as deputy highway commissioner for the Pennsylvania Highway Department, at Harrisburg, and was resident engineer in charge of the construction of the Brooklyn extension of the New York City Rapid Transit Subway. Going to California many years ago, Mr. Leffingwell had a civil and mining engineering practice in Los Angeles and a consulting practice in Bishop, Calif.

Chauncey Arthur Pierce (Assoc. M. '18) chief engineer for the H. D. Best McCaffrey Co., of New York City, died on February 18. He was 69. Mr. Pierce served the McCaffrey Co. as chief draftsman on design of reinforced concrete mercantile buildings, and since 1916 had been chief engineer. Earlier he was employed by the Hudson & Manhattan Railroad, in New York; the Titan Steel Casting Co., in Newark, N.J.; and the Edison Electric Illuminating Co., in Brooklyn, N.Y.

Joseph Wagoner Sheppard (Jun. M. '40) civil engineer for the Tennessee Valley Authority, at Knoxville, died on March 1. He was 31 and a graduate of the University of Louisville. At the start of his career, Mr. Sheppard was employed by the Louisville Cement Corp. as engineering draftsman.

Randolph Truslow Townsend (Jun. M. '50) lieutenant in the U.S. Army, was killed in action in Korea, on February 8. His age was 24. He was a June 1950 graduate of the Virginia Military Institute, where he had been a member of the ASCE Student Chapter.

Sumner Paddock Wing (M. '30) for the past four years in charge of the foreign activities programs for the Bureau of Reclamation, in Washington, D.C., died on March 22, at the age of 60. Mr. Wing was preparing to lead a Point IV engineering team to Libya on a water resources development project there. Before joining the Bureau of Reclamation as an engineer 21 years ago, he did engineering work in Italy and Korea and served as chief civil engineering designer and assistant to the chief engineer of the British Columbia Power Corp. He was a Stanford University graduate.

Sumner P. Wing

NEWS OF ENGINEERS

John J. Manning, vice-admiral, CEC, U.S. Navy (retired), has been elected president and director of James Stewart & Co., Inc., engineering and construction firm with offices in New York, Chicago, Washington, and Dallas. Formerly chief of the Bureau of Yards and Docks of the Navy Department, Admiral Manning has filled many important assignments in the Navy, including director of the Construction Department of the Bureau of Yards and Docks in Washington, D.C., at the beginning of the Navy's shore facilities expansion program and director of the Seabee operations in Europe and North Africa during the invasions of Sicily, Italy, and Normandy.

Admiral Manning

Charles W. Cooke is now head of the Hartford, Conn., Public Works Department. Mr. Cooke was with the city engineering department from 1914 to 1949, as assistant director.

Albert C. Bardin, of Salinas, Calif., has gone to Greece, where he will make surveys for an ECA reclamation project, covering more than a million acres of crop lands. Mr. Bardin is connected with the Los Angeles consulting engineering concern of Leeds, Hill & Jewett, which is associated with the Knappen, Tippetts, Abbett Engineering Co., of New York, on the project.

Nicholas V. Back, since 1938 assistant engineer for the New York Central Railroad in New York City, has been appointed maintenance-of-way engineer of the Toronto, Hamilton & Buffalo Railway, an affiliate organization. His headquarters will be in Hamilton, Ont.

R. M. Arenz, for the past three years with the Bureau of Public Roads, at Portland, Oreg., has become engineer in charge of highway planning and survey work in the Bureau's office, at Missoula, Mont.

Walter T. Brooks, formerly state highway engineer, at Knoxville, Tenn., has been appointed engineer for Hamilton County, Tennessee, with headquarters at Chattanooga.

Carl Wright Brown, chief engineer of the Missouri State Highway Department since 1936, has been designated an outstanding alumni of the University of Missouri's College of Engineering. Mr. Brown received the university's first honor award for distinguished service in engineering during the recent Engineers' Convocation at the University.

Lawrence F. Wagner, who has been associated with the Ocean County, New Jersey, engineers' office for 23 years, has been named acting engineer, succeeding the late **J. C. Remington, Jr.**

G. O. Billmire is now state engineer of Maryland in charge of the Department of Public Improvements, with offices in Baltimore. Formerly he served as assistant chief engineer of the department.

Claude H. Chorpening, recently promoted to the rank of brigadier general in the Civil Engineer Corps of the Army, has been named Assistant Chief of Engineers for Civil Works, Washington, D.C. Previously General Chorpening served as chief of the Personnel Division of the Corps of Engineers, and was district engineer, at Tulsa, Okla.

General Chorpening

E. G. Johnson, formerly bid estimator for the Utah Construction Co., San Francisco, Calif., has been appointed chief engineer of the Utah State Road Commission, with headquarters in Salt Lake City. **W. L. Anderson** was named assistant chief engineer in charge of bridges and design.

James K. Carr has been named consultant on reclamation matters to the House Committee on Interior and Insular Affairs, Washington, D.C. For the past 15 years Mr. Carr has been engaged in various engineering and administrative capacities by the Bureau of Reclamation on its Central Valley Project in California. More recently he served as district manager of the Sacramento District at Chico.

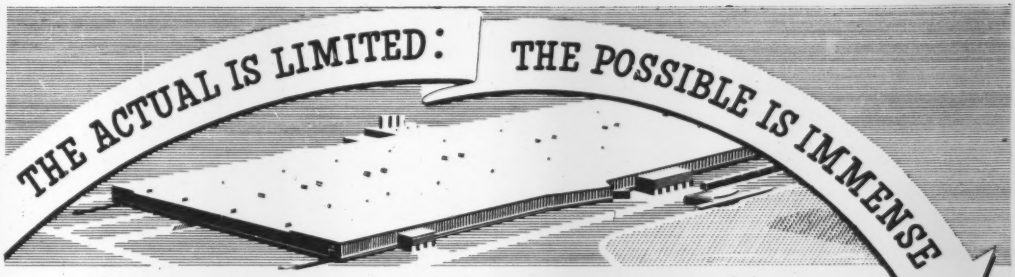
James K. Carr

Philip P. Farley, since 1918 consulting engineer to the borough president of the Borough of Brooklyn, has retired.

John C. Bridger, since 1946 professor of civil engineering at the University of Tennessee, Knoxville, has been recalled to active duty in the Navy, with the rank of lieutenant commander. He has been assigned to the Public Works Department of the 13th Naval District, at Seattle, Wash.

Algert D. Alexis, rear admiral, CEC, USN, public works officer and officer-in-charge of construction at the Norfolk Naval Shipyard, Portsmouth, Va., has been made director of the Atlantic Division of the Bureau of Yards and Docks, with headquarters in New York, N.Y. He is also serving on the staff of the Commander, Eastern Sea Frontier and the Commander in Chief, U.S. Atlantic Fleet.

(*Continued on page 84*)

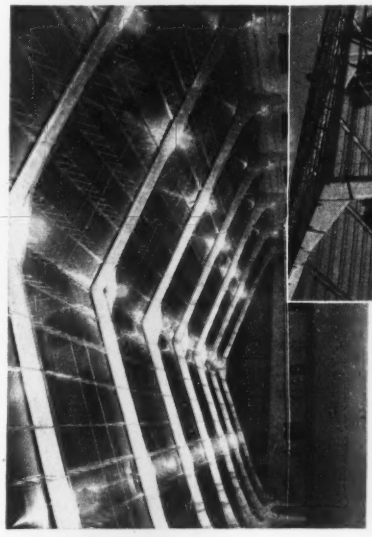


NEW LINCOLN PLANT CREATED BY INCENTIVE-INSPIRED CO-ACTION IN DEVELOPING POSSIBILITIES IN PRODUCT

© LE Co. 1951

WELDED DESIGN CUTS STEEL TONNAGE 20%

By **David R. Graham**
Consulting Engineer
Tulsa, Oklahoma



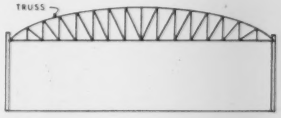
Gymnasium with welded frame construction. Needs fewer men to erect. Interior is cleaner . . . easier to light.

It has been shown that savings of 20 per cent in the tonnage of steel can be made by taking advantage of the rigidity of welded connections in the design of a structure. It may be stated safely that the cost of a building is dependent far more on planning than it is on current cost levels.

By utilizing the structural rigidity of welded frames in the example shown, six to eight feet of height in masonry walls can be eliminated. For a building of 80' x 120' this means a reduction in cost of $6000 based on $2 per square foot of wall area . . . a saving of 6 to 10 per cent in total cost of construction.

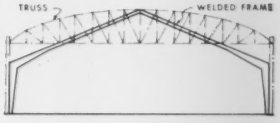
Welded structures can also be erected in less time. Frame members are shop fabricated at low cost with fast, downhand welding. Field connections are then bolted, guyed and welded in less time and with less scaffolding than required with other types of construction.

the ACTUAL



Traditional Design *costs $8 to $10 per square foot. Needs higher exterior walls and additional masonry.*

increasing the YIELD



Welded Frame Construction Saves 50%. *Cost is only $40,000 or $4.16 per square foot for building 80' x 120'.*

the IMMENSITY of the POSSIBLE

more space,
more headroom
per dollar

SEE HOW WELDED DESIGN BUILDS BETTER BUILDINGS

Studies in Structural Arc Welding free on request. Write on your letterhead to Dept. 142,

THE LINCOLN ELECTRIC COMPANY
CLEVELAND 1, OHIO

News of Engineers

(*Continued from page 82*)

Merrill C. Lorenz, until recently assistant chief of the Supply and Procurement Division of the St. Louis, Mo., District of the Corps of Engineers, has become director of the Processes Division in the Evaluation Department of the U. S. Naval Civil Engineering Research and Evaluation Laboratory, at Port Hueneme, Calif.

R. E. McDonnell

R. E. McDonnell, co-founder and senior member of Burns & McDonnell Engineering Co., Kansas City, Mo., has retired after 53 years of consulting engineering practice, though he will continue to serve the firm in an advisory consulting capacity. Mr. McDonnell has specialized in the municipal utility engineering fields of water, sewage, and power. His firm has served 887 cities in the United States on such projects.

Robert A. Charmillon, who is associated with Fenwick, S.A., of Paris, France, has been placed in charge of that company's new office in Casablanca, French Morocco.

Robert K. Mason is now field project manager for the Du Pont Co., general contractor on the Atomic Energy Commission project near Aiken, S.C.

John P. Connelly, formerly administrative assistant to the service director of Dayton, Ohio, has been named manager of the Dayton Municipal Airport.

James F. Pou, previously manager of the building division of the Carolinas Branch of the Associated General Contractors of America, Inc., has been appointed assistant director of foundations at North Carolina State College, Raleigh.

Stifel W. Jens

Stifel W. Jens has opened an office for the practice of hydrologic, hydraulic, and sanitary engineering, at 101 South Meramec Avenue, St. Louis, Mo. For the past 18 years Mr. Jens has been associated with the St. Louis firm of Horner & Shifrin, serving as a partner since 1939. He recently acted as chairman of the ASCE Committee on Hydrology and played an important part in the preparation of the *Hydrology Manual*.

Philip O. Macqueen, since 1936 chief of the Engineering Branch of the Water Supply Division of the Washington, D.C., District office of the Corps of Engineers, has retired after 38 years of service in the Corps.

David B. Steinman, New York City consultant and bridge authority, was awarded membership in the Society of Sigma Xi, national honorary scientific organization, at the recent annual meeting of the Columbia University chapter.

Albert H. Hinkle, senior engineer on the district engineering staff of the Asphalt Institute, at Cincinnati, Ohio, has been promoted to division engineer.

Peter J. Reidy has been elected president of the Structural Engineers Society of New York. Mr. Reidy is president of Purdy & Henderson Associates, Inc., consulting engineers of New York.

Percy L. Coleman, chief structural engineer in the general engineering department of the Monsanto Chemical Co. since 1943, has accepted a similar post with C. J. Smith & Co., consulting engineers of St. Louis, Mo., where he took over his new duties April 1. Formerly Mr. Coleman was associated with Albert Kahn, Inc., associated architects and engineers of Detroit, Mich.

Joseph B. Tiffany

Joseph B. Tiffany has been appointed assistant director of the Waterways Experiment Station, at Vicksburg, Miss. Formerly Mr. Tiffany held the position of special assistant to the director, with additional duty as chief of the Technical Services Division. He has been connected with the Corps of Engineers for 22 years, the past 18 at the Experiment Station. **Charles B. Patterson,** previously head of the Research Center, succeeds Mr. Tiffany as chief of the Technical Services Division.

Leslie W. Stocker, recently retired senior civil engineer for the Public Utilities Commission of the City and County of San Francisco (California), has entered private practice, with headquarters at his residence —15 San Leandro Way, San Francisco. In the employ of the city almost 44 years, Mr. Stocker worked on the development, construction, and operation of the Hetch Hetchy water supply and power system and the San Francisco Airport.

Mark B. Owen, formerly a member of the consulting engineering concern of Russell B. Moore Co., Indianapolis, Ind., is now vice-president in charge of the Indianapolis office of the Nichols Engineering and Research Corp., of New York, N.Y.

A. L. Pauls has been named vice-president of the J. A. Jones Construction Co., at Charlotte, N.C. He will also continue as project manager on the Buggs Island job for the Jones-Thompkins-Wright Co.

Robert L. Sumwalt, dean of the School of Engineering, University of South Carolina, was elected chairman for the coming year of the Southeastern Section of the American Society for Engineering Education at its recent 17th annual meeting held at Biloxi, Miss. **ASCE Vice-President D. V. Terrell,** dean of the School of Engineering, University of Kentucky, was elected vice-chairman, and **Prof. B. M. Bayer,** of Vanderbilt University, was reelected secretary-treasurer.

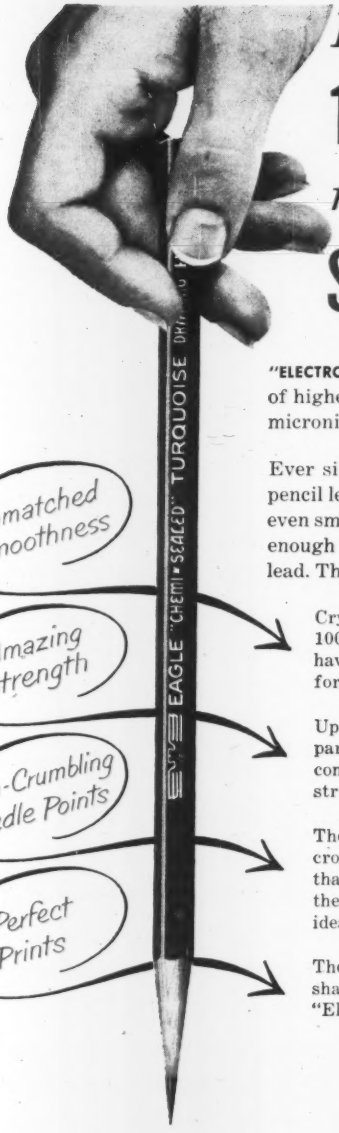
Andrew Komora, Ann Arbor, Mich., consultant, is now chief engineer for the Damodar Valley Corp., with offices in Calcutta, India.

Robert F. Olds has retired from his position as chief of the Division of Operations in the Office of the Division Engineer, Corps of Engineers, at Portland, Oreg.

Mortimer R. Lewis, irrigation engineer of Washington, D.C., has gone to Lebanon under the Point Four project to develop the Litani River Valley. Mr. Lewis has made drainage and irrigation investigations for the Department of Agriculture and for two years was consultant to Venezuela on similar matters.

(*Continued on page 86*)

ASCE PRESIDENT GAIL A. HATHAWAY, Special Assistant to Chief of Engineers, Department of the Army, is made honorary member of Japan Society of Civil Engineers in his office at Gravelly Point, Va. Presentation was made by Kiyoo Meguro, chairman of six-man Japanese Mission on Flood Control and Watershed Management now touring the United States. Other members of Commission attending ceremonies, are, left to right, Takaski Ogawa, Shigeto Fujimura, Saburo Yamamoto, Ichiro Yamanouchi, and Yoshio Hosoya. Mr. Hathaway was recently in Japan as official guest of Japan Society of Civil Engineers, while en route from India where he headed the United States delegation to the international engineering conferences and exhibitions in New Delhi and Bombay.



Here's why

100% "Electronic" Graphite

makes the new Turquoise

Serve You Still Better

"ELECTRONIC" is Eagle's trade name for a blend of crystalline graphites of highest purity from Madagascar and Ceylon, reduced to particles of micronic fineness in our patented Attrition Mill.

Ever since we tested our first pound of "Electronic" graphite in fine pencil leads and found how much they were improved by the addition of even small amounts, we have planned for the day when we could process enough of this super-graphite to use it 100% in every TURQUOISE lead. That day has come! Here's what it means on your drafting board:

Crystalline graphite is nature's perfect lubricant. Leads made with it 100% have a frictionless, smooth-gliding quality impossible in leads having the usual content of amorphous graphite which contains harsh foreign materials.

Upon reduction, the graphite crystals break down into microscopic particles of infinitely varied, close-interlocking shapes. The clay binder completes an extremely dense ceramic structure . . . the strongest lead structure ever achieved.

The particles of "Electronic" graphite are so fine that millions more crowd into the air spaces in the lead, producing a richer, tighter lead that deposits more particles, more evenly, at every stroke. That's why the new TURQUOISE lead holds a needle point better than ever and is ideal for long, even lines.

The finer the particles of crystalline graphite, the blacker, denser and sharper is the line deposited on the paper. Drawings made with 100% "Electronic" graphite reproduce to perfection.

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TURQUOISE

WITH 100% *"ELECTRONIC" GRAPHITE

PROVE IT YOURSELF
Order TURQUOISE today from your dealer. Or write us for a sample in any degree you desire.

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News of Engineers

(Continued from page 84)

Richard E. Dougherty, Past-President of ASCE, left the New York Central System on March 31 to engage in private practice as a consulting engineer. He will act as consultant for the firm of Seelye, Stevenson, Value & Knecht and will have offices with them at 101 Park Avenue, New York City. On the engineering staff of the New York Central since 1902, Mr. Dougherty retired in 1948 as vice-president assistant to the president and since then has been advisory consultant for the system. He has served ASCE as Director and Vice-President and as President in 1948. He has also been active in Engineers Joint Council, and is a member of the Commission on Renovation of the White House.

R. E. Dougherty

Donald D. Curtis, professor and head of the department of mechanics and hydraulics at Clemson College, was recently elected Grand Regent of the Theta Tau fraternity.

Virgil E. Gunlock, commissioner of subways and superhighways for Chicago, Ill., took office as president of the Illinois Society of Professional Engineers during the recent annual meeting. **H. F. Sommerschield,** secretary of the ASCE-Illinois Section, and **F. W. Edwards,** director of the department of civil engineering at the Illinois Institute of Technology, were elected to the board of directors.

Robert E. Dunning, director of construction for the Atomic Energy Commission at Los Alamos, N. Mex., has accepted the post of chief of the Laboratory Engineering Branch there.

Philip B. Fleming, major general, CEC, U.S. Army (retired), Under Secretary of Commerce for Transportation, Washington, D.C., was recently nominated by President Truman to the post of Ambassador to Costa Rica. General Fleming was chairman of the Maritime Commission from June 1949 until July 1950 when its functions were transferred to the Commerce Department and he became Under Secretary of Commerce.

Calvin Friar, sales engineering assistant at the Technical Experiment Station of the University of Maine, Orono, has entered the employ of Stone & Webster, in Boston, Mass.

Eugene A. Hardin, until recently principal engineer for the City of Philadelphia, Pa., has joined the staff of Parsons, Brinckerhoff, Hall & Macdonald, New York City engineering firm. Mr. Hardin was previously engaged on both the water works expansion program and the sewage disposal project for Detroit, Mich., and several consulting firms in Kansas City and Chicago.

Carlos G. Lopez, manager of Casa Lopez, of Quito, Ecuador, has been reelected to the post of president of the Sociedad de Ingenieros y Arquitectors del Ecuador.

Robert C. White, since 1941 chief operating officer of the Missouri Pacific Lines, at St. Louis, Mo., has retired after a career of 46 years. Mr. White has served the railroad in the St. Louis office, successively as assistant chief engineer, general superintendent of the Eastern District, assistant general manager, and chief operating officer.

William Holman, until recently with the New Jersey State Highway Department, has become research assistant in the civil engineering department at Rutgers University, New Brunswick, N.J.

Walter P. Warendorff, formerly area engineer of the Veterans Administration, New York City, is now assistant chief of maintenance and operation of the construction services of the VA in Washington, D.C.

Lorenz G. Straub was reelected president of the International Association for Hydraulic Research at its recent fourth meeting in Bombay. The next meeting of the association will be held in 1953 at the University of Minnesota, where Professor Straub is head of the civil engineering department and director of the St. Anthony Falls Hydraulic Laboratory.

Charles V. Chapman, instructor in civil engineering, University of Maine, has reported to the Army for active duty.

Seelye, Stevenson & Value, New York City consulting firm, announces the admission of **A. Wilson Knecht,** a mechanical engineer, to the firm and a change in the firm name to Seelye, Stevenson, Value & Knecht. The other members of the firm are ASCE Members **Elwyn E. Seelye, Albert L. Stevenson,** and **Burnside R. Value.**

Ned Williams, for the past three years assistant to the director of the Office of Production and Engineering of the Atomic Energy Commission, at Oak Ridge, Tenn., has been named director.

George E. Watson, Harry Touby, and **Frank E. Watson** announce the opening of professional offices under the firm name of Watson, Touby & Watson, in Miami, Fla.

Harold D. Hauf has resigned as editor-in-chief of *Architectural Record*, with headquarters in New York City, to accept a call to active duty in the U.S. Navy with the rank of commander. He will serve as coordinator for design and construction in the District Public Works Office at the First Naval District Headquarters in Boston, Mass. Before going to *Architectural Record* in 1949, Mr. Hauf was chairman of the department of architecture and professor of architectural engineering at Yale University.

Harold D. Hauf

RECENT BOOKS

ASTM Standards on Industrial Water

The various ASTM standard and tentative methods of sampling, analysis, and testing of water employed industrially in the generation of steam or for process or cooling purposes are contained in *ASTM Standards on Industrial Water*, prepared by ASTM Committee D-19 on Industrial Water. The examination of deposits formed from such waters is also covered as well as methods of reporting test results. A list of standard definitions of terms and a bibliography of ASTM publications in the field are given. (American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1951. 160 pages. $2.)

Engineering Mechanics

This text by S. Timoshenko and D. H. Young, entitled *Engineering Mechanics*, aims to acquaint the student with as many general methods of attack as possible, and to illustrate the application of these methods to practical engineering problems. In this third edition, the chief aim has been to improve the lists of unsolved problems. McGraw-Hill Book Co., New York, Toronto, London, 1951. 517 pages. $5.50.

(A) Practical Handbook of Water Supply

This handbook, by F. Dixey is written for those who deal with providing or improving the water supplies of small communities in arid and semi-arid areas. The geological aspects of water supply are described in detail, and the practical aspect of retaining or of recovering water is treated from the layment's point of view. Changes in this second edition reflect the advances made in the past nineteen years in the finding, conservation, and development of minor water supplies. Allen & Unwin (Thomas Murby & Co.), London, 1950. 373 pages, 35s.

Structural Theory and Design

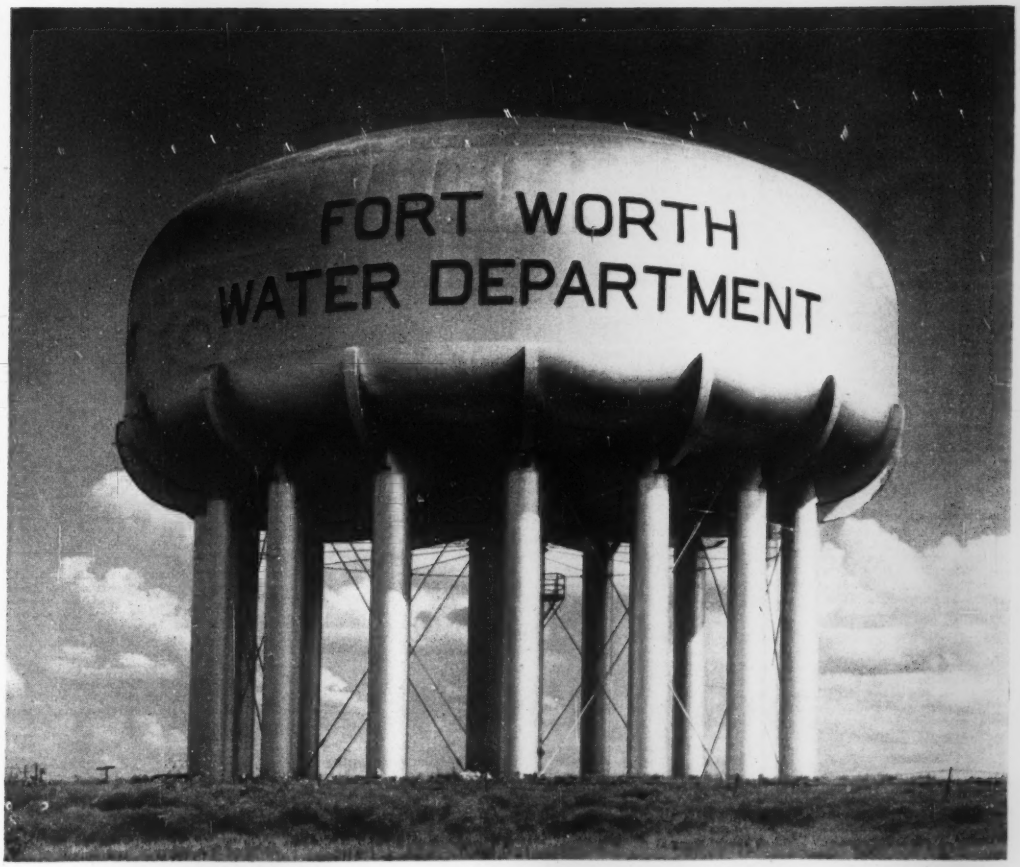
Volume I of this two-volume set, by J. M. Young, covers the more elementary part of the subject under the following chapter headings: Structural materials; structural mechanics; structural analysis (cantilevers and simply supported beams); deflections of beams, etc.; fixed and continuous beams; design principles; simple framed structures; and columns and struts. Advanced theory and design will be dealt with in Volume II. Crosby Lockwood & Son, Ltd., 39 Thurloe St., London, S.W.7, 1950. 283 pages, 25s.

(The) Theory of Vibrations for Engineers

The gap between an elementary treatment and the important analyses needed in the correction and elimination of vibrations is bridged in *The Theory of Vibrations for Engineers*, by E. B. Cole. This second edition is enlarged and almost completely rewritten. Vector methods are used in the solution of problems, and many new examples are added. Only the most elementary knowledge of the calculus is assumed as a full explanation of all advanced mathematical processes is given. Crosby Lockwood & Son, Ltd., 39 Thurloe St., London, S.W.7, 1950. 334 pages, 18s.

Welded Deck Highway Bridges

This book, *Welded Deck Highway Bridges*, edited by J. G. Clark, is devoted to information obtained from the designs entered in the "Welded Bridges of the Future 1949 Award Program," of the James F. Lincoln Arc Welding Foundation. The rules of the program limited each exhibit to an all-welded design for a two-lane deck highway bridge supported on two piers 120 ft apart. The material presented is divided into chapters on structural types, floor systems, etc., to permit a comparison of the designs. James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, 1950. 247 pages, $2.



Why Fort Worth Depends on Distributed Water Storage

Take a quarter million people living in a metropolitan area of 73 square miles—and provide them with a water supply that is both dependable and economical. That is the basic problem that daily confronts the Fort Worth Water Department. It's not much different from the water problems faced by other large cities throughout the world—but the solution shows a most modern approach.

Fort Worth has five different pressure planes in its distribution system. Each is, in reality, a separate water system with its own elevated storage and distribution mains. The unifying factor is the central pumping station that supplies water to all five districts.

Recently, the 2,000,000-gallon Horton tank shown above was installed in the southern pressure area. It boosts elevated storage capacity 400 per cent and provides more uniform water pressure. This tank has a relative large diameter and shallow depth which reduces the range in head between the upper and lower water levels. As a result, pumping costs are substantially lower.

Many cities depend on distributed elevated storage to increase water pressure, lower pumping costs, and provide a ready reserve of water for emergencies. Horton elevated tanks with radial-cone bottoms are built in capacities ranging from 500,000 to 3,000,000 gallons. Smaller tanks with ellipsoidal-bottoms are built in standard capacities from 15,000 to 500,000 gallons.

If you are planning a new or improved water system, consider Horton elevated storage. Write our nearest office today for more details. There is no obligation.

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Tulsa 3 ..... 1647 Hunt Bldg.
Washington 6, D. C. .... 1156 Cafritz Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

New Publications

National Housing Policies. A brief narrative of the development of federal housing activities and the evolution of a national housing policy over the past 20 years is provided in *A Summary of the Evolution of Housing Activities in the Federal Government*, a 24-page booklet issued by the Housing and Home Finance Agency, Washington, D.C. Copies are available from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., at 10 cents each.

Stainless Steel. To familiarize architects, builders, and engineers with the rapidly growing fund of technical data on stainless steels, the American Iron and Steel Institute has made available a new two-color booklet, *Architectural Uses of the Stainless Steels*. The publication illustrates successful applications, shows some of the stock parts available, and features design details in ten pages of drawings. Write to the Committee of Stainless Steel Producers, American Iron and Steel Institute, 350 Fifth Avenue, New York, for further information.

City Planning. Designed as a practical aid for cities in dealing with the ever increasing problems of traffic, parking, slum clearance and urban development, *Creating Better Cities* is a complete report on the Third Businessmen's Conference on Urban Traffic Problems, held in Washington, D.C., November 20–21, 1950. Problems besetting every municipality at the present time, including considerations of national defense are considered. This book may be obtained from the Chamber of Commerce of the United States, Washington, D.C., at $1 per copy. Quantity prices on request.

Philadelphia Improvements. Continuing its city-wide program of public improvements, the Philadelphia City Planning Commission has issued recommendations for the six-year period, 1951–1956, in an illustrated brochure entitled *Program of Public Improvement*. Copies are available from the Commission, Market Street National Bank Building, Market and Juniper Streets, Philadelphia 7, Pa.

Snow Melting. A comprehensive treatise on snow melting systems for roads, driveways and sidewalks has been written by T. Napier Adlam under the title *Snow Melting*. Detailed tables on amount of snowfall, air venting, pipe friction, pump selection, costs of installing and operating, and complete information on proper installation are included in the volume which is published by the Industrial Press, 148 Lafayette St., New York 13, N.Y., and sells for $4.50 each.

Highway Research Board. Issuance of Bulletin No. 32 of the Highway Research Board, consisting of a transcript of a panel discussion on *One-Way Streets* which was held at the twenty-ninth annual meeting, is announced. The bulletin includes a brief and informal statement by each of six panel members of his experiences in the installation and operation of one-way streets and transcripts of ensuing discussions. Copies may be purchased for 60 cents each from the Highway Research Board, 2101 Constitution Avenue, Washington, D.C.

Engineering Research. Scientific progress on more than 150 widely varied research projects is described in the 1950 Annual Report of the Armour Research Foundation of Illinois Institute of Technology entitled *Research for Industry*. Copies may be obtained by writing to the Armour Research Foundation, Illinois Institute of Technology, Technology Center, Chicago 16, Ill.

Test Data. Data on 437 selected borings in the City and County of San Francisco have been published in diagrammatic form in a volume entitled *Selected Logs of Borings in the City and County of San Francisco*. The volume was compiled by the U.S. Geological Survey and the Institute of Transportation and Traffic Engineering of the University of California. Published as Information Circular No. 11 in the Institute of Transportation and Traffic Engineering Series, it may be purchased for $3 per copy from the University of California Press, Berkeley 4, Calif.

Mississippi River Flow. Detailed stream-gaging records for the lower Mississippi Valley for 1948 are available in *Stages and Discharges, Mississippi River and Its Outlets and Tributaries, 1948*, compiled by the President's Office, Mississippi River Commission, Corps of Engineers. The remittance of $1 per copy should be sent to the Office of the President, Mississippi River Commission, Corps of Engineers, Vicksburg, Miss. Checks or express money orders should be made payable to the Treasurer of the United States.

UNESCO. A brief review of the achievements of UNESCO during its first five years, and a program for the future is presented in outline form in *UNESCO: Five Years of Work*. Copies of the report, prepared by the Mass Communications Department of UNESCO, are available on request from the UNESCO Relations Staff, Department of State, Washington, D.C.

Water Pollution. A description of the extent of pollution along the waters of the St. Clair River, Lake St. Clair, St. Mary's River from Lake Superior to Lake Huron, and the Niagara River from Lake Erie to Lake Ontario is presented in the *Report of the International Joint Commission of the United States and Canada on the Pollution of Boundary Waters*. Recommendations for the abatement of pollution are also included in the report, which may be obtained by writing to the offices of the Commission in Washington or Ottawa.

Water Resources. Two bulletins of the Division of Water, Department of Natural Resources, State of Ohio, are now available. Bulletin No. 19, by Stanley E. Norris, with parts by Richard P. Goldthwait and William P. Cross, summarizes investigations of the geology and water resources of Greene County, made in 1947 and 1948 to determine availability and quality of the ground and surface water. Bulletin No. 21, by Paul Kaser, consists of the records of water-table fluctuations. Inquiries should be addressed to the Division of Water, Department of Natural Resources, State of Ohio, Columbus, Ohio.

Movable Bridges. Vertical lift, bascule and other types of movable bridges are discussed in a profusely illustrated work, *Anti-friction Bearing Design for Movable Span Bridges*. Bridge engineers who desire a copy should write on company stationery to The Torrington Co., Bantam Bearings Division, South Bend, Ind.

United Nations. The answer to the question, "Where can I find materials about the UN?" may be found in *The UNESCO Story*, a 112-page resource and action booklet published by UNESCO. The booklet may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., for 55 cents. A 25 percent discount is allowed on orders of 100 or more.

Water Pollution. Excerpts from the President's Water Resources Policy Commission's report, *A Water Policy for the American People*, discussed in the January 1951 issue of CIVIL ENGINEERING (page 72) are presented in Public Service Publication No. 58, entitled *Water Pollution Control*. The two chapters on Pollution Control and Domestic and Industrial Water Supply are emphasized and parts of other chapters from the original report are also included. The publication may be obtained from the Federal Security Agency, Public Health Service, Division of Water Pollution Control, Washington, D.C.

Atomic Energy. A summary of the progress of the Atomic Energy Commission for this year is presented in its *Ninth Semi-annual Report*. Methods used in contracting with industries, research institutions, and universities and colleges are briefly reviewed. The report may be obtained from the U.S. Government Printing Office, Washington, D.C.

Beach Erosion. New studies in wave phenomena, beach erosion, and allied subjects have been issued by the Beach Erosion Board. These include Technical Memorandum No. 19 on "Submarine Topography and Sedimentation in the Vicinity of Mugu Submarine Canyon, California"; No. 20, outlining "Beach Cycles in Southern California"; and No. 21, discussing "The Interpretation of Crossed Orthogonals in Wave Refraction Phenomena." Further information may be obtained by writing to the Office of the Chief of Engineers, Beach Erosion Board, Corps of Engineers, Department of the Army, Washington, D.C.

Engineering Research. Material on the research program of the radiant heating laboratory at Montana State College is presented in its recent Bulletins 10 and 11—"Flow Measurement by Pipe Elbows," by H. F. Mullikin and J. M. Batch, and "Indentation Characteristics of Floor Coverings Used Over Radiant Floor Panels," by H. F. Mullikin and L. C. Horpedahl. Also available is Bulletin No. 12 on "Portland Cement Concrete," by R. C. Hart. Address all inquiries to the Engineering Experiment Station, Montana State College, Bozeman, Mont.

Engineering Instruments. The complete line of W. & L. E. Gurley, pioneer makers of surveying and engineering instruments, is described in the company's revised edition of Catalog No. 50. Copies of the Catalog are available on request to W. & L. E. Gurley, Troy, N.Y.

(Continued on page 92)

Louisville Convention of ASCE
Hotel Brown, June 13–15, 1951

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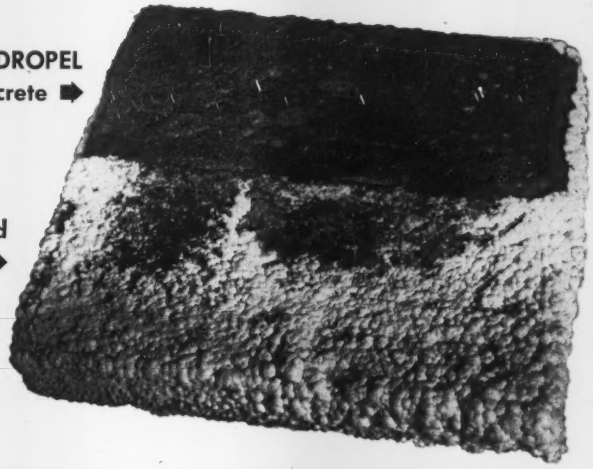

This block—one-half HYDROPEL Concrete and the other half air-entrained—sat in a shallow layer of saturated salt solution until all liquid evaporated. The solution was sucked through the air-entrained concrete by capillarity, leaving salt crystals on the surface. Note that the HYDROPEL Concrete absorbed almost none of the salt solution—free from destructive salt crystallization.

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If YOUR concrete suffers from stresses induced by alkali or salt absorption, freeze-thaw action, moisture changes, or just plain abrasive wear—HYDROPEL Concrete will give you much longer life, at low cost. (We make no claim against strong acids.)

HYDROPEL is a unique type of liquid asphalt emulsion, added as the concrete is mixed. It gives you MANY benefits. Why not try HYDROPEL on one of your TOUGH spots? Here are a few of the many problems in concrete that HYDROPEL has solved.

Case History No. 1

In a Northeastern state with severe climate, a new concrete highway soon scaled badly—and bridge decks showed many cracks. Sections of the same highway, laid with HYDROPEL Concrete, remained perfect—no scaling, no cracking. HYDROPEL repaid its small added cost, many times over.

Case History No. 2

A group of new homes in Lima, Ohio, were built with the first floor well below grade—with walls and floors of concrete. In one house, HYDROPEL Concrete was used as a test. Torrential rains came. Where ordinary concrete was used, the houses had to be pumped out. The "HYDROPEL house" was the only one that stayed dry. Tests of all well-known admixtures proved that HYDROPEL Concrete resists capillary moisture approximately FIVE TIMES better than any other admix.

Case History No. 3

A Connecticut city was plagued with early disintegration of concrete in their curbs, gutters and sidewalks—from freeze-thaw action and de-icing salts. HYDROPEL Concrete was ordered used in all these locations. Inspection, after several years' use, showed the HYDROPEL Concrete to be in perfect condition.

Case History No. 4

A chemical plant, making chlorine and caustic from brine solutions, had very short life of their concrete electrolytic cells. About three years ago, they made new cells of HYDROPEL Concrete. This plant, and others like it, report that HYDROPEL Concrete cells last twice as long with double the amperage formerly used—a gain of 400% in effective cell life. In resisting alkali salts, HYDROPEL Concrete has given large savings, in a variety of applications.

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- **Bitumuls Sand-Mix** . . . . . ☐
- **Bitumuls Handbook** . . . . . ☐
- **Hydropel**—Admix for concrete . . . ☐
- **Tennis Courts**—Laykold & Grasstex . ☐
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The Engineering Societies Personal Service, Inc., has many outstanding engineering positions available through the United States and for foreign service. Make your availability known to the office of the Engineering Societies Personnel Service, Inc., nearest your home. Never before in the 30-year history of the Service has there been greater opportunity for members of the engineering profession in all its branches, mechanical, electrical, civil, mining and metallurgical, chemical, naval architecture, etc. Now is the time to find the opportunity you have been waiting for, but the initial step must be taken by you.—Alfred H. Meyer, Executive Director.

Men Available

CIVIL ENGINEER, Assoc M. ASCE; 39; married; registered; 12 years' experience in municipal engineering design and construction work and 2 years' industrial plant experience. Interested in job as assistant to responsible man in administration, planning, or manufacturing work in United States or Latin America. C-665.

CIVIL ENGINEER, Jun. M. ASCE; B.S. in C.E. 1950; M.S. in C.E. this June; structural major; 33; married; ex Marine Corps Officer, over 6 years active duty; capable of administrative leadership; adaptable personality; much initiative, originality; wide and varied experience in working with and supervising people outside engineering. Desires position with large consulting or design organization. C-667.

RESIDENT ENGINEER, Assoc. M. ASCE; licensed P.E., New York State; 41; 10 years in responsible charge of public works projects, including highways, large grading projects, park and beach development, foundations, and miscellaneous heavy construction. Desires position as resident or project engineer. Willing to travel in United States. C-668.

CIVIL ENGINEER, Jun. M. ASCE; B.S. C.E., 1949; 27; married; 2 years' experience in estimating and technical writing in field office on construction of dam and power plant; desires to locate in New York City or northern New Jersey. C-669.

ENGINEER, M. ASCE; licensed P.E., Member of American Institute of Mining and Metallurgical Engineers, Member of American Association of Engineers; desires position as field engineer with mining company or individuals located preferably in southwestern United States. C-670-976 Chicago.

CIVIL ENGINEER; Assoc. M. ASCE; 49; married; registered P.E.; 14 years' responsible charge highway engineering and construction; 11 years' responsible charge airports, waterfront, and utilities. Prefers Northwest or Alaska, however location is immaterial. C-671-5012 A-1 San Francisco.

ENGINEER, research; Assoc. M. ASCE; 35; married; 3 years structural design and drafting, including special problems research; 5 years reinforced concrete research. Location preferred, western United States. C-672-513 A-8 San Francisco.

CONSTRUCTION ENGINEER, Assoc. M. ASCE; 43; married; with some 20 years of construction and engineering experience on major construction and engineering contracts. Desires position as coordinator or project manager, large scale housing projects, general construction or sales engineer. Would consider foreign assignment. C-673-513 A-12 San Francisco.

STRUCTURAL ENGINEER, Jun. M. ASCE; registered structural engineer, Nebraska; B.S. C.E.; married, 2 children; 3 years USNR, current status Lt. jg., CEC, inactive reserve, call unlikely; 4 years chief structural engineer for architect's office employing 25. Desires comprehensive United States or foreign position offering more than straight design. C-674-977 Chicago.

Positions Available

CIVIL ENGINEER, graduate, 35-50, thoroughly experienced in bridge and grade separation work, road and railroad facilities, industrial buildings, sewage and water treatment plants, and sewer, water, and drainage facilities. Experience in the preparation of plans, specifications and contract documents. Will supervise several engineers and draftsmen, do some design, specification and report work, but most important, should be able to supervise effectively subordinate personnel, obtaining efficient productivity and desirable personnel conditions. Salary, $6,600-$7,500 a year. Location, Louisiana. Y-5062.

CIVIL ENGINEERS. (*a*) Civil engineer, graduate, with experience in water works construction for a half million dollar project. After completion of project will supervise operation of plant. Must have some experience in hydraulic design. Permanent. Salary open. Location, upstate New York. (*b*) Civil engineer, recent graduate, for work in construction, engineering, and installation on a water utility. Some hydraulic design experience desirable. Salary open. Location, Long Island, N.Y. Y-5096.

PROJECT ENGINEER, 35-55, civil graduate preferred, but chemical or mechanical graduates considered who have had experience in design and construction of chemical buildings. Must have at least 5 to 10 years' experience in the supervision of construction, including industrial or chemical plants, and preferably also office buildings and similar projects. Prefer 2 years' experience on design or related engineering work in the office in connection with industrial or chemical plants, and at least 2 years in responsible management position. Salary, $7,500-$9,000 a year. Location, upstate New York. Y-5107.

ENGINEERS. (*a*) Resident engineers, 28-45, for supervision of building construction. Civil or building construction degree preferred, with at least 2 years or more experience in the supervision of construction, including specific experience in the building construction field, and preferably at least a year's experience in design or other similar engineering activities in the office. (*b*) Resident engineer, 30-45, for the supervision of chemical plant construction, with chemical, civil, or mechanical degree, and at least 4 years' experience in the supervision of construction, including at least 2 years on chemical plant work, and at least a year's experience in design work in the office for chemical engineering projects. Salaries, $5,000-$7,300 a year. Location, upstate New York. Y-5108.

ENGINEERS. (*a*) Civil engineer, graduate, with major in hydraulics, and 2 to 5 years' experience in the design and operation of industrial water plants and distribution systems, to design water distribution systems. Must have working knowledge of deep rock wells, be familiar with operation of water cooling towers, and be familiar with pump operations, selection, and maintenance. Salary, $3,900-$4,800 a year. (*c*) Junior civil engineer, with bachelor's degree required, master's desirable. Will initially do technical clerical work and handle small engineering jobs, until familiar with the methods, procedures, and general operating conditions. Will then be given work in his particular field, and will if necessary be relieved of all office engineering work. Salary, $3,900-$4,800 a year. Location, New York State. (*d*) Architectural or civil engineer with bachelor's degree necessary and master's desirable, and with 2 to 5 years' experience in structural design and construction, preferably in small buildings such as garages, large houses, etc. Will look after small buildings, alterations, and renovations. Salary, $3,900-$4,800 a year. Location, New York State. Y-5164.

CHIEF FIELD ENGINEER with hydrographic survey, river and harbor development, and general dredging experience, to take charge of field engineering. Must go on single status. Duration 2 years. Salary, $7,200-$9,000 a year plus room and board. Location, Venezuela. Y-5197.

PLANNING TECHNICIANS (2), graduates from recognized college or university with major work in city planning, civil engineering, architecture, landscape architecture, or other related acceptable field, for work including map delineation, preparation of base maps, charts, graphs, statistical research, field surveys of blighted areas, miscellaneous city planning, and redevelopment work. Location, Westchester County, New York. Y-5245.

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Positions Available

ENGINEERS. (a) Construction foreman, about 40, with general construction experience, including roads and other earthwork projects, pile structures, and simple buildings. Tropical experience and a working knowledge of Spanish desirable. Single status for 6 months. Draft exempt. Salary, $4,800 a year, plus maintenance while in the field camp and a $80 a month bonus. (b) Surveyor engineer, civil graduate, or a non-graduate thoroughly familiar with plane surveying. Must have ability to make all necessary computations as well as to perform the actual field work. Experience in the tropics preferred. Single status for 6 months. Draft exempt. Salary, $4,560 a year, plus maintenance while in the field camp and $60 a month bonus. Location, Colombia, S.A. Y-5248.

SEWERAGE ENGINEERS OR WATER WORKS ENGINEERS for assignments abroad in connection with housing and community development. Must be United States citizens, requiring security clearance. Salaries open. Headquarters: Washington, D.C. Y-5256.

SANITARY ENGINEER with sewage-disposal plant design and construction experience for field work with contractor on government construction project. Temporary, 3 or 4 months. Salary $170 for 6-day week. Location, central New York State. Y-5274.

STRUCTURAL ENGINEER with at least 5 years' experience on design of hydraulic structures, to take charge of structural design section on large irrigation project. Salary, $9,000–$12,000 a year. Location, Greece. Y-5283.

ENGINEERS. (a) Water works engineer with at least 10 years' design experience in municipal water distribution systems, to take complete charge of design of water distribution system. Salary, $10,000–$12,000 a year. (b) Junior engineer with 2 to 5 years' water supply experience, to assist in design and layout of distribution system. Salary, $6,000–$8,000 a year. Location, Israel. Y-5284.

CIVIL ENGINEER for design work on park and parkway development. Five years' general design experience in minor structures, utilities and roads, with some field experience desired. Location, Michigan. Y-5316.

Meetings and Conferences

American Congress on Surveying and Mapping. The annual meeting of the American Congress on Surveying and Mapping will take place at the Hotel Shoreham, Washington, D.C., June 18–20.

American Management Association. General management will be the theme of the American Management Association meeting, at the Waldorf-Astoria in New York City, June 7 and 8.

American Institute of Electrical Engineers. Headquarters for the Great Lakes District meeting of the American Institute of Electrical Engineers will be the Hotel Loraine, Madison, Wis., May 17–19.

American Society for Quality Control. Quality control in military procurement will be a major topic of discussion at the fifth national convention of the American Society for Quality Control, to be held in the Cleveland Public Auditorium, Cleveland, Ohio, on May 23 and 24.

American Society for Testing Materials. A wide range of subjects in the field of engineering materials is scheduled for coverage at the 54th annual meeting of the American Society for Testing Materials, to be held at the Chalfonte-Haddon Hall in Atlantic City, N.J., June 18–22, inclusive.

American Society of Mechanical Engineers. Mechanics of solids will be discussed during the Applied Mechanics Division meeting of the American Society of Mechanical Engineers, at Stanford University, Stanford, Calif., on June 22 and 23. The meeting overlaps the Heat Transfer and Applied Mechanics Institute, which is to be held at the university June 20–22.

Society of Automotive Engineers. The summer meeting of the Society of Automotive Engineers will be held at the French Lick Springs Hotel, French Lick, Ind., June 3–8.

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New Publications

(*Continued from page 88*)

Educational Exchange. Activities of the U.S. Advisory Commission on Educational Exchange and the Department of State in the field of international education are outlined in Department of State Publication 3892, International Information and Cultural Series 12. The publication, which is entitled *Two-Way Street*, may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., for 60 cents.

Materials Testing. Descriptions and prices of various publications of the American Society for Testing Materials including a number to be issued shortly, are presented in a booklet called *ASTM Publications*. Address all inquiries to the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.

Positions Announced

Panama Canal. Several civil engineering vacancies are available in the Panama Canal service on construction of towns for employees. These include one Civil Engineer (Townsite Planning), Grade GS-13, at $9,500 per annum, for a period of two years; one Civil Engineer (Townsite Planning), Grade GS-12, at $8,000 per annum, for a period of two years; two Civil Engineers (Sewer and Water Systems, Roads, Grading), Grade GS-9, at $5,750 per annum in townsite planning, for an indefinite period; and four Civil Engineers, Grade GS-7, at $4,781.25 per annum, with specialty in sewer and water systems, roads, and grading or surface drainage in townsite planning, for an indefinite period. Applicants must be college graduates, with experience suitable to the position applied for. They must be American citizens in good physical condition, and not over 45 years of age (62 for persons entitled to veterans' preference). Inquiries should be addressed to the Chief of Office, Panama Canal, Washington 25, D.C.

National Advisory Committee for Aeronautics. Announcement of a civil service examination for aeronautical research interns in science and engineering, to fill positions paying $3,100 a year in the various field laboratories of the National Advisory Committee for Aeronautics, is made. To qualify, applicants must have a college education, with option in an appropriate field. Further information and application forms may be secured from any Civil Service Commission or post office, or the U.S. Civil Service Commission, Washington 25, D.C.

U.S. Public Health Service. Competitive examinations for appointment of officers as sanitary engineers in the regular commissioned corps of the U.S. Public Health Service will be held in various cities throughout the country on August 6, 7, and 8. The examination will include professional written tests, an oral interview, and a physical. Applicants must have a B.S. degree in civil, sanitary, or chemical engineering, with at least three additional years of experience. Full information and application forms may be obtained from the Surgeon General, U.S. Public Health Service, Federal Security Agency, Washington 25, D.C., attention, Division of Commissioned Officers, Desk A.

Applications for Admission to ASCE, Mar 10–April 14

Applying for Member

BALDWIN, HARLAND SCOTT, Kansas City, Mo.
BRASWELL, SAMUEL ERIC, Columbus, Ohio.
BURKS, CHARLES HAMPTON, Jacksonville, Fla.
CURLIN, WILLIAM PRATHER, Frankfort, Ky.
DECKER, MORRIS TRUMAN, Caracas, Venezuela.
GARDNER, DAVID IVAN, Midvale, Utah.
GARDNER, ELZA LOYD, St. Paul, Minn.
HOWARD, ARTHUR EARLE, Lebanon, Beirut.
KOFLER, DOV JACK, Tel Aviv, Israel.
KUMPE, EDWARD FENLON, Lawrence, Kans.
MACDONALD, ALBERT FREDERICK, Pittsburgh, Pa.
MACKAY, JACK WHITING, Birmingham, Ala.
MARION, JOSEPH PIERRE, Chicago, Ill.
MATTICE, MALCOLM COWAN, Ithaca, N.Y.
NICHOLSON, HAROLD HARTZELL, Fort Pect, Mont.
SAYERS, DOUGLAS ROBERT, New York, N.Y.
SIMPSON, EARL CARLTON, Olympia, Wash.
WARWICK, SPENCER JOSEPH, Nashville, Tenn.
WINKELMAN, HORACE HERMAN, Milwaukee, Wis.

Applying for Associate Member

BASKIN, BENJAMIN, Detroit, Mich.
BHATTACHARYYA, SIMIL KUMAR, Northumberland, England.
BUSH, ALBERT FRANCIS, Los Angeles, Calif.
COATE, JAMES WENDELL, Omaha, Nebr.
COMELLA, WILLIAM OLIVER, Dover, Del.
CONLEY, HUGH GORDON, Los Angeles, Calif.
DAVIS, JOHN HICKS, Dallas, Tex.
DYCKMAN, WILLIAM TOMPKINS, New York, N.Y.
EVERSON, JOHN EDWARD, New York, N.Y.
HARMS, JOHN EDWARD, JR., Baltimore, Md.
KRAETTLI, MARVIN FREDRICK, Partlesville, Okla.
LAL, MANSUMRAT, Ajmer, India.
MATHIAI, HOWARD FREDERICK, San Francisco, Calif.
MITTON, DENIS LEONARD, Pinelands Cape Town, South Africa.
MCCARTHY, JOHN TIMOTHY, New Rochelle, N.Y.
MOOREHEAD, ERIC OAKMAN, Berkeley, Calif.
MURPHY, LAWRENCE KENNETH, Augusta, Me.
NACHLINGER, LESTER LOUIS, Kansas City, Mo.
O'NEILL, RAYMOND PETER, Napa, Calif.
PEREZ, ROBERT PAUL, Berkeley, Calif.
RYDZ, BARRY, Denver, Colo.
SLEPETYS, ZIGMAS, São Paulo, Brazil.
STANDISH-WHITE, DENNIS WILLIAM, Denver, Colo.
THOMPSON, ARTHUR KILE, Indianapolis, Ind.
VERMA, RAMJEE PRASAD, Cambridge, Mass.
WILLIAMS, HAROLD, Jeffersonville, Ind.
WOODS, PHILLIP EDGAR, Gardiner, Maine.

Applying for Junior Member

ACOSTA SIERRA, CARLOS JOSE, Caracas, Venezuela.
BERRY, LEO KENNETH, San Francisco, Calif.
EATON, FRANK LEVI, Balboa, Canal Zone.
EVANS, RONALD WILLIAM, Lewisham, NSW, Australia.
GOSS, DEAN LEE, New York, N.Y.
GRAHAM, DAVID MATHEW, North Hollywood, Calif.
HARTZELL, CARL DANIEL, Walnut Creek, Calif.
HAW, SHERWOOD GORDON, Ann Arbor, Mich.
HOLMAN, JOHN, Rio de Janeiro, Brazil.
HUTTO, JAMES ALBERT, Nashville, Tenn.
IP, LAI, Salt Lake City, Utah.
JORTBERG, ROBERT FRANCIS, Troy, N.Y.
KESL, WILLIAM ARTHUR, Chicago, Ill.
KHALEEL, MUHAMMAD, Knoxville, Tenn.
LEE, FREDERICK KWAI FOOK, Honolulu, Hawaii.
LIEBERMAN LITMANOWITZ, LEOPOLDO, Atlanta, Ga.
LUCIANO, ROBERT EDWARD, Springfield, Mass.
MILLER, GEORGE JAMES, St. Louis, Mo.
NEWTON, DONALD WINSTON, Boulder, Colo.
O'NEILL, JOSEPH DONALD, Valdez, Alaska.
RAMIREZ, LIONEL QUINONES, San German, Puerto Rico.
REED, PORTER ALLEN, Dallas, Tex.
ROGERS, JOHN CLEMENT, Mount Holly, N.C.
ROICHEL-KAGAN, CLAUDE ANCELME, New York, N.Y.
RUSS, ROBERT STORRS, Willimantic, Conn.
SHADDICK, WILLIAM THOMAS DUNCAN, London, England.
SHIH, TSZE-SHENG, Detroit, Mich.
SWOFFORD, RAYMOND PIERCE, JR., Baytown, Tex.
WHITE, HAROLD ELMER MARCHANT, Hazleton, Pa.
WINDHAM, JACK EDWARD, Corpus Christi, Tex.

UNIV. OF ALABAMA

Carter, Gilbert, Jr.
Hines, James Thomas, Jr.
Smith, Claude Herbert

UNIV. OF ARKANSAS

Kellow, Bill Gean
Lambert, Laurence Hosea
McKinstry, Joe Lee

UNIV. OF CALIFORNIA

Allard, Paul Andrew
Prior, Robert George
Ricks, Gordon Albert

(Continued on page 94)

SIMPLEX
TYPE HF
WEIR METER

IT'S SIMPLEX
IT'S ACCURATE

The Simplex Type HF water float operated meter is ingeniously adaptable to measuring liquid flows across weirs.

It may be considered as a standardized form of installation with weirs of the **Notched, Rectangular, Sutro, Broad Crested or Submerged types** for which mathematical flow formulae already have been developed. It may also be used with other types of weirs for which established flow formulae do not exist, but which permit laboratory or field rating to obtain the necessary head quantity relationship.

By its use, flow data is provided from any measurable maximum to ten percent of this maximum, the average error at any point over this range not exceeding plus or minus two percent.

The Type HF Meter may be furnished as a wall mounted unit, for large panel installation or for individual steel floor stand mounting as shown.

Whenever a single head flow measuring instrument is required to operate with weirs of accepted design or otherwise, the type HF meter offers an excellent solution to this measuring problem.

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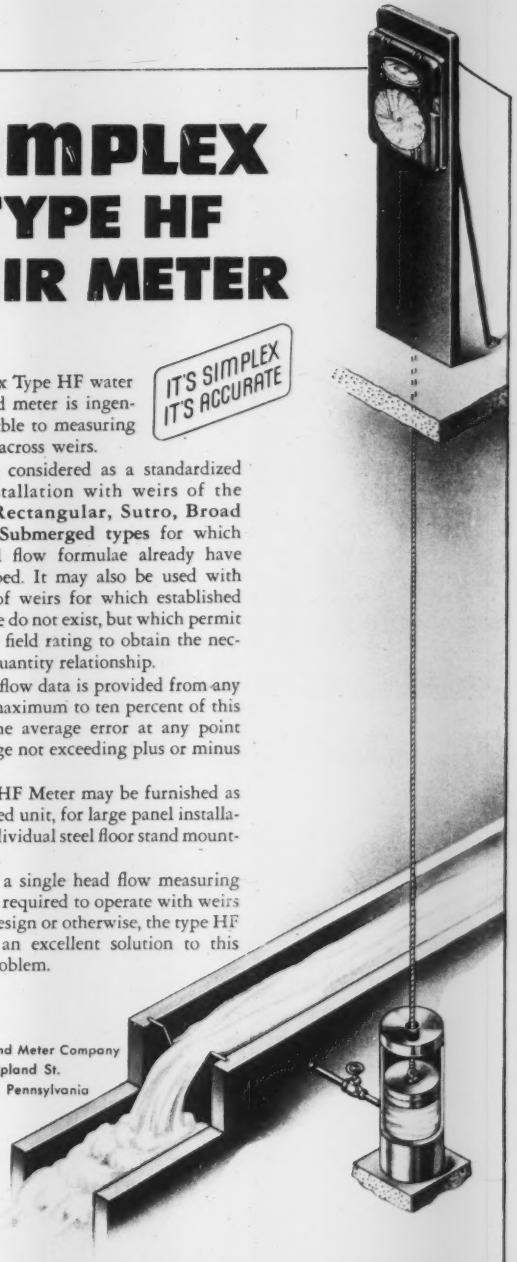
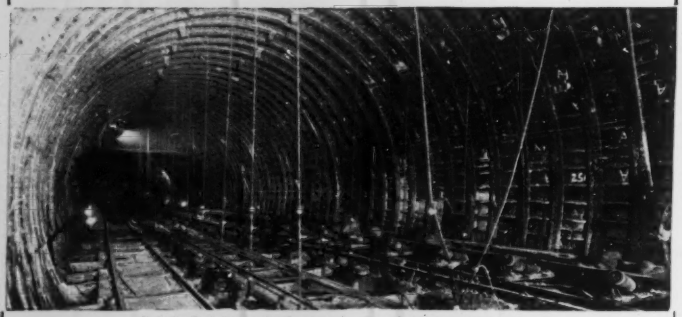
Dept. 5, 6724 Upland St.
Philadelphia 42, Pennsylvania



SIMPLEX
VALVE AND METER COMPANY

COMMERCIAL IMPROVED TUNNELING PRACTICE

FOR THE LARGEST TRAFFIC TUNNELS



Project: East Boston Traffic Tunnel. One of two largest in U. S.

The fastest, most efficient, and least expensive method of driving large traffic tunnels is through the use of COMMERCIAL Steel Liner Segments. Witness their numerous applications on the largest tunnels in the country, both under ground and water. The most recent COMMERCIAL choice has been for tunnels on the Pennsylvania Turnpike . . . a wise choice, indeed, considering the time limit on almost all of these tunneling jobs. They do the *large* jobs more rapidly. Let us tell you more about COMMERCIAL LINERS . . . they're adaptable to any size tunnel. Write today.

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ASCE Applications

(Continued from page 93)

Stauff, John Henry
Stokes, Hayman Wilson
Wing, Albert David

CLEMSON A. & M. COLL.
Arnold, Thomas Leslie
Brinson, Hugh Eugene
Croke, Thomas Michael
Gibson, Robert Hoyle, Jr.
Leavy, Carl Ferdinand

COLORADO A. & M. COLL.
Signs, Wesley Eugene

UNIV. OF DENVER
Cammarata, Anthony Joseph

UNIV. OF FLORIDA
De Groot, Kenneth
Spangenberg, Theodore Sanders
Sullivan, Martin, Jr.

GEORGE WASHINGTON UNIV.
Mazenderani, Abrahim Khajavi

UNIV. OF HAWAII
Wong, Rodney Kwei Fong

UNIV. OF ILLINOIS
Kell, Bobby Maxswane
Schnepper, Donald Herman
Vodick, Milan Andrew

ILLINOIS INST. TECH.
Alsterda, John Richard
Hahn, Jerome Marquette
Klein, Herbert Henry
Magnusen, David Lowell
Mortison, Adrian Owen
Munger, John William
Nigro, Emil Francis
Pages, Richard Etienne
Rohlf, Jack Hans
Turek, Joseph Richard
Walsh, Donald Anthony
Weigle, John Benjamin, Jr.
Zapfel, Walter John

IOWA STATE COLL.
Berg, William Edgar

KANSAS STATE COLL.
Handlin, Lloyd John
Stallbaumer, Valerian Leo
Webster, Ronnie Gill

UNIV. OF KENTUCKY
Fox, Clarence Clemis

LOUISIANA POL. INST.
FLEMING, ROY CURTIS

UNIV. OF MAINE
Prince, Elbert Marshall

MARQUETTE UNIV.
Bruckwick, Richard Leonard
Burke, Edmund Martin
Dallman, Calvin Henry
Dinauer, Charles Robert
Dretzka, Kenneth Mark
Eberle, James Herbert
Grimm, Thomas George
Hinzmann, John Joseph
Holland, William John
Holzhauer, Walter Carl
Johnson, Benjamin H.
Kessler, Lloyd Lester
Kipp, Raymond Joseph
Lewin, Donald Henry
Opine, Owen Robert
Rech, Thomas Clarence
Rotunno, Joseph Rocco
Scaffidi, John Anthony
Schmidt, Richard Thomas
Wacker, Louis Harvey
White, Robert James

UNIV. OF MINNESOTA
Bambenek, Benjamin Franklin, Jr.
Simpkins, Eugene Michael

UNIV. OF MISSOURI
Berry, Thomas Maxwell
Norton, Gerald Allan

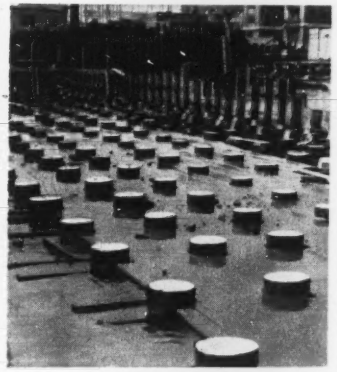
UNIV. OF NEVADA
Hasler, Milton Herschal, Jr.

COLLEGE CITY OF N.Y.
Laing, Edward Bruce
Yusha, Milton

NEW YORK UNIV.
Patrao, Plinio

OHIO STATE UNIV.
Dowalter, Richard Maple
Moorhead, Robert Eugene

Relieving platform, supporting New York's East River Drive, rests on 72,000 creosoted piles. Wood form, pictured here, carries reinforced concrete slab.



72,000 CREOSOTED PILES support Famous Parkway

New York's East River Drive, completed in 1942, is one of the city's most impressive waterfront parkways. It is about 7 miles long, and carries two-way, high-speed traffic in 6 lanes. For a distance of 4.3 miles, relieving platform bulkheads were built along the shore of the East River to support the highway. These relieving platforms rest on approximately 72,000 creosoted timber piles, driven offshore in water 20 to 30 feet deep.

Permanent . . . Economical

Pressure-creosoted piles were specified because of their permanence and economy. The pressure-creosoting treatment protects these piles against marine borers . . . also against decay and insect attack where cutoffs are above the water table.

Write for Quotations

For projects requiring permanent construction *with economy*, Koppers Pressure-Creosoted Piles may be the best answer. These piles usually cost less than other permanent pile materials. Koppers Piles come in lengths up to 130 feet.

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Coley, Jack Francis
Dimatteo, Frank Anthony
Hodgson, Joe Milton
Mullen, Karl Kelly
Nicek, Charles P.
Pence, Edwin Hoag
Walden, Samuel Mason

OREGON STATE COLL.
Kohler, Keith Fred

UNIV. OF PUERTO RICO
Velez, Jose Antonio Coca

PURDUE UNIV.
McClellan, Harold Dale
Nishimura, Katsuyoshi
Sizemore, Raymond Lewis

RENSSELAER POL. INST.
Canham, George Joseph
Sosenko, Andrew

SOUTH DAKOTA STATE COLL.
Collins, Eugene Perry
Contreras y Villalba, Manuel E.
Hansen, Ernest Wayne
Kukuk, Donald Harris
Lee, Lawrence Arthur
Odland, Kenneth Gabriel
Rickher, James Glennon
Rutsch, Albin George
Schwartz, Wendell Eugene

UNIV. OF SOUTHERN CALIFORNIA
Erb, Paul Cranston

SOUTHERN METHODIST UNIV.
Ellisor, Elmer Wats, Jr.
Kelley, Nash LaRoe
Tanner, John Thomas, Jr.

SYRACUSE UNIV.
Walker, Robert Charles
Webber, Robert Eugene

UNIV. OF TEXAS
Creel, Louis Guy, Jr.
Etheridge, Obie Leonard
Gilbert, James Albin
Morris, William Clinton
Richardson, Earl, Jr.
Smith, Donald Burdett

TEXAS A. & M. COLL.
Bennett, Percy James, Jr.
Boone, Clyde Davis
Carroll, Floyd Jewel
Collins, Tyrus Fields
Cone, William Marion
Coston, William Edward
Couch, Billie Lynn
Durham, Morris Compton
Frias, Juan Samuel
Hall, Marvin Ronal
Jackson, Alton Rutherford
Johnson, William Thomas, Jr.
Kinsey, Raymond Alexander
Lawler, Robert William
Pierce, Richard Clayton
Polk, John Tyler
Shockley, Harold Joseph
Stephenson, Billy L.
Whittington, Charles Dean

UNIV. OF TOLEDO
Pasztor, William George

VANDERBILT UNIV.
Burger, Donald Herman

UNIV. OF VIRGINIA
Echols, Charles Ernest

WASHINGTON UNIV.
Kowal, Walter

UNIV. OF WASHINGTON
Burghardt, Cornelius Roderick
Chase, William Joseph

WASHINGTON STATE COLL.
Smith, Norman Elmer

STATE COLL. OF WASHINGTON
Goldberg, Allen

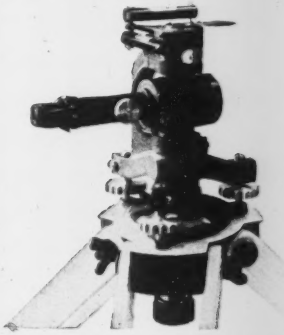
WEST VIRGINIA UNIV.
Tavernit, Samuel Vincent

BERGER solves another Engineering problem.

Fast accurate measurement on long vertical sights

sight upward and downward with extreme accuracy

without altering position of instrument



- **Align elevator shafts accurately, speedily . . .**
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- **Align suspension bridges; set piers, canal locks . . .**
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- **Take necessary sights in mine shafts . . .**
- **Transfer ground control points to top of high street towers or bridge structures . . .**
- **Set turbines and generators . . .**

Virtually indispensable in first order triangulation

Tested and proven over years of service, BERGER vertical collimators have solved the problem of accuracy and time-saving where vertical sights are crucial in construction. The process is direct—NO TRIAL AND ERROR.

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Send me information on the vertical collimator

Name .....
Title .....
Company .....
Address .....
City ..... Zone .... State .....

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Crawler Tractor

TRACKLAYING, ROADBED GRADING, car spotting, loading or unloading for contractors, railroads, industrial plants, mining operations, docks or warehouses is possible with a crawler tractor operating on rails. Specially designed ESCO track-walking shoes with flanges corresponding to the flanges on a car wheel enable the tractor to run on standard gauge railroad track like any piece of rolling stock and it is able to mount or dismount the rails at will without injury to the rails. Off the rails the ESCO track-walking shoes do not affect normal every-day tractor performance. The tractor may be used as an off-track bulldozer or an on-track car spotting locomotive at the will of the operator and without time loss. Ask for Bulletin No. 190. **Electric Steel Foundry Company, 2141 N.W. 25th Ave., Portland 10, Ore.**

Concrete Saw

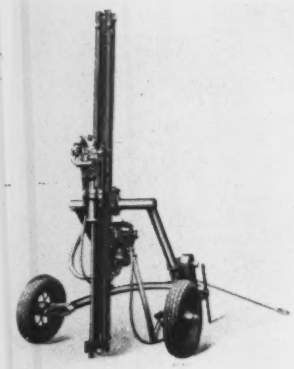
A SELF-PROPELLED SAW for cutting concrete and asphalt has been announced. Known as the Model 51 Self-Propelled Concut, the sawing machine is used for sawing concrete and asphalt streets, concrete floors, airport runways, etc., prior to the breaking and removal of the material,

Model 51

thereby assuring a smooth, straight edge for patching. Other uses include sawing contraction joints, sawing for the installation of expansion joints, grooving for crack control, grooving ramps and steps for safety, etc. The self-propelled feature increases the life of the cutting blade and speeds the sawing operation. Other features include a dash panel showing water pressure gauge, spindle speed tachometer, motor throttle, cut-off switch and transmission control lever. The lever lock control feature, enables the operator to remove the blade from the cut, then lower it to the same depth without changing adjusting screw. The self-propelled concut is powered by a 13.3 hp gasoline engine to provide ample power for toughest sawing and uphill operation. Cutting depth is determined by the size of the blade being used. **Concrete Sawing Equipment, Inc., 15 North Oakland St., Pasadena 1, Calif.**

Wagon Drill

A WAGON DRILL known as the FM-3, is announced. The unit is designed to permit unlimited drilling positions of the tower or drill guide. It is recommended for the toughest drilling jobs in road building, construction, quarrying and foundation work or for any job where a large volume of sustained high-speed drilling is required. The flexibility of the unit per-



Model FM-3

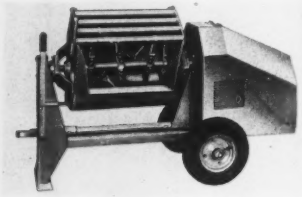
mits easy drilling in any position encountered in modern rock excavation. The yoke can be lowered within the frame itself placing the drill in the lowest desired position for toe hole work. For higher holes a hoisting mechanism, consisting of a powerful worm and pinion gear actuated by a ratchet handle, easily raises the drill in a few moments. Vertical drilling close to a face is easy because the drill extends out beyond the limits of the carriage when the roller-bearing swivel mounted wheels are turned 90 deg. With the wheels locked at right angles the FM-3 is ideal for line hole work. A slide mounted variable pressure feed-motor assures the right working pressure for any drilling conditions. It can be placed where it is most convenient for the operator. The tower is also slide-mounted on a standard sliding cone permitting additional flexibility when needed. A one-piece tubular steel frame combines lightness and rigidity. The unit is equipped with a two quart capacity lubricator to provide ample lubrication for an entire day's work. It is designed for easy filling and cleaning. The FM-3 mounts the powerful, heavy-duty Ingersoll-Rand X-71-WD rock drill as its drilling unit. **Ingersoll-Rand Company, Dept. RD, 11 Broadway, New York 4, N.Y.**

Silicone Base Water Repellent

A CLEAR SILICONE BASE WATER and stain repellent for porous or semi-porous masonry and mortar joints has been developed. The repellent, "Cor-O-Pel," penetrates the surface to more than $\frac{1}{4}$ in., and leaves the surface non-glossy and unchanged in color or texture. The material may be applied with a spray gun or with a brush. **Con-Cor Paint Co., 4550 Main St., Kansas City, Mo.**

Mixer

A $\frac{1}{2}$ BAG PLASTER AND MORTAR mixer known as the "Mix-Miser," featuring easy portability is being manufactured. Of 3 cu ft capacity, it is designed for use on small jobs requiring a limited mix and for larger construction where it is desirable to keep the mixer close to the work, thus reducing hodding costs. The over-all width of 29-$\frac{1}{2}$ in. permits this No. 3 mixer to be rolled through most standard doorways and it can be swung through windows with a light hoist. The weight is 535 lb without engine. The low charging height of 36-$\frac{3}{4}$ in., and hinged protecting grid permits safe charging without stopping the machine. Design allows drum to be tipped past discharge position so it may be

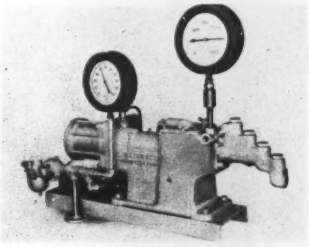


The Mix Miser

hosed out and cleaned thoroughly. Corrosion of bearings is said to be eliminated by "labyrinth" packing glands which protect drum bearings from seepage of lime and cement. Mixing shaft and drum are suspended on four self-aligning ball-bearing units for low fuel or power use. For low maintenance, replaceable blade and hoe assemblies are bolted, not welded to shaft. Drive with either gasoline or electric motor is through positive gear trains with correct reductions, all housed under heavy steel hood to exclude weather and "slop." Power available, Briggs & Stratton 2.3 hp air-cooled gasoline engine or 1 hp single phase electric motor, 110/220 v 60 cycle. Length 62 in. with tongue telescoped; drum 20-$\frac{1}{4}$ in. dia., 24 in. long; shell 11 gauge steel, heads $\frac{3}{16}$ in. Wheels, pressed steel with 4.00 x 8 pneumatic tires 16 in. over-all. **The Knickerbocker Co., 638 Liberty St., Jackson, Michigan.**

Pressure Generator

THE VERSATILITY of the "airoymetric" pressure generator for a broad field of hydrostatic test applications has been demonstrated. The unit is combined with a group of specially designed simplified controls to develop test pressures up to 25,000 psi using ordinary plant air supply in the pump cylinder. Each of the pumps develops a discharge pressure ratio range of at least 6 to 1, permitting single pump use for applications requiring various test pressures. Individual units may be cus-



For Hydrostatic Testing

tom made for specific applications between 25 psi and 25,000 psi. The pressure generator has use in the hydrostatic testing of boilers, forgings, castings, tubings, pipes and piping systems, pressure gages, valves, vacuum pumps, dryers, and high pressure hose, among others. Capacities range from 4 gph to 405 gph; pressures from 25 psi to 25,000 psi with ordinary plant air supply. The "airoymetric" pressure generator is self-reciprocating, and in operation pumps continuously and automatically at maximum capacity in building up the desired pressure in the system. When a balance is reached between the air pressure and the corresponding hydrostatic test pressure, the pump automatically stops. The technique of balancing air input pressure against desired hydraulic pressure gives the hydrostatic test unit extreme flexibility, simplicity, safety, and low cost. Ordinary city water, or oil from a supply tank, flowing through the pump permits rapid filling of large capacity vessels. The pump then builds up and maintains the required pressure automatically, thus eliminating the constant attendance of an operator. The pump can be supplied with a portable dolly for taking it to the job. **Milton Roy Company 1302 E. Mermaid Lane, Philadelphia 18, Pa.**

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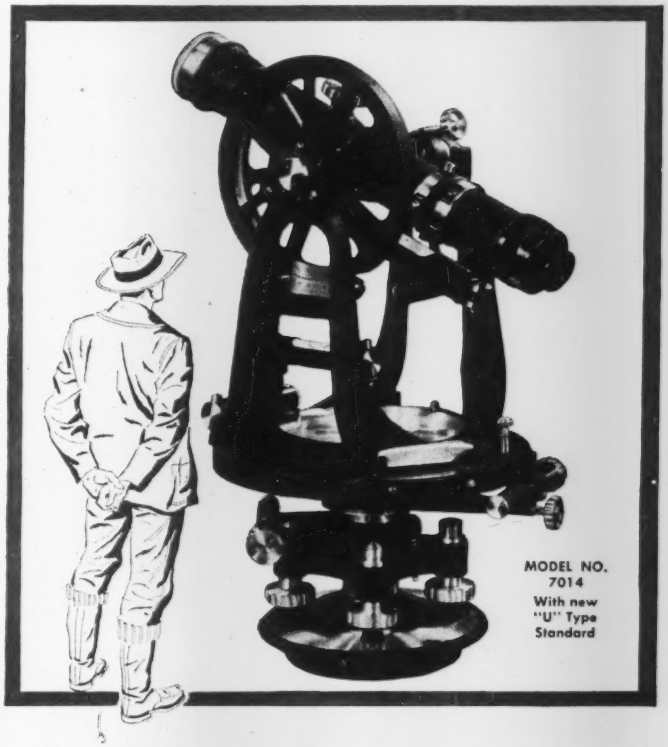
Have you seen the important NEW FEATURES on the WHITE Engineers' transit



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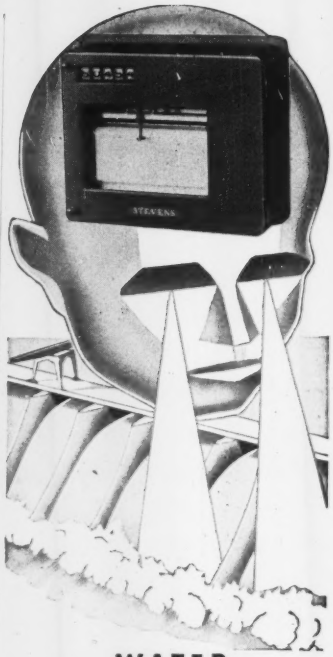
Equipment, Materials & Methods (Continued)

Concrete Testing Machine

REDESIGNED TO SEPARATE the loading and weighing units, a concrete testing machine of 100,000 lb capacity is announced. The two-unit design prevents transmission of load shocks to the indicator and keeps the operator out of range of flying or falling particles from breaking specimens. Welded construction of the loading unit and simple structural lines of both units have greatly improved the appearance of the machine. The testing machine is similar in operation to the 90,000 lb machine which it replaces. It is designed primarily for testing 2 in. cubes and 3 in. by 6 in. cylinders but the stroke and dimensions of the working space are large enough to permit many other uses. The loading unit has a clear space of 17-5/8 in. between columns and a maximum opening of 22-1/4 in. between ram and upper platen. Ram travel is 3 in. at speeds up to 1¼ in. per minute. The loading rate is controlled by means of a pacing indicator and manually operated valve which varies the pump discharge to the hydraulic loading cylinder. Load can be increased at a constant rate of 4000 lb per sq in. per minute on 3 in. cylinders and 2 in. cubes when operating on the 100,000 lb dial; and at 4000 or 1000 lb per sq in. per minute on 2 in. cubes when operating on the 10,000 lb dial. The ranges provided on the two 16 in. diameter dials, 0-100,000 and 0-10,000 lb, are graduated in 200 lb and 20 lb increments respectively. The hands are driven by Emery precision Bourdon tubes activated by an independent Emery cell built into the loading ram. Accuracy of load measurements is within plus or minus 1% at indicated load or 0.2% of full scale capacity, whichever is greater. **Baldwin-Lima-Hamilton Corporation, Main St., Lima, Ohio.**

Building Insulation

FIBERGLAS BUILDING INSULATION for homes is now available in longer rolls. The longer rolls require less cutting and fitting, fewer packages to handle and afford a better continuous vapor barrier which more than meets FHA requirements. Because they are compression packaged, the rolls are easier to handle, require less shipping space and can be installed more quickly than the old rolls. When unrolled and installed the Fiberglas insulation springs back to its natural density. Light in weight, Fiberglas building insulation is composed of fibrous glass drawn from molten sand and other selected minerals at more than 2400 degrees Fahrenheit. The fibrous glass contains no elements that can burn. This insulation requires less storage space during construction, transports easily without damage, and provides no problem of disposal of outer wrappings. Fiberglas building insulation is also available in the form of batt blankets, utility batts and pouring and blowing wool, to meet particular needs in home insulating and construction. **Owens-Corning Fiberglas Corporation, Toledo 1, Ohio.**



WATER MEASUREMENT OR CONTROL

STEVENS

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Write for literature and information on accurate and dependable STEVENS water measuring instruments.

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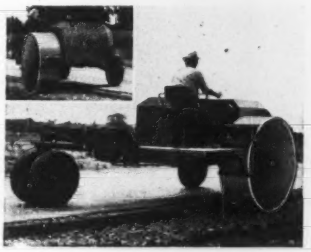
PORTLAND 13, ORE., U. S. A.

Equipment, Materials & Methods (Continued)

Trench Roller

THE TRENCH ROLLER has many important features which make for ease of operation and more effective compaction. These features include hydraulic mechanism for operating the dual steering wheels which ride on the pavement, hydraulically controlled leveling wheels, and extra-large diameter variable weight compression roll. Adjustments are provided to quickly level roller to suit any trench requirements. Frame has sufficient clearance to enable roller to work in any depths to 25 in.



Features Ease of Operation

Hydraulic control, thru the use of a single lever, keeps the machine on a level or horizontal plane from 6 in. above to 25 in. below road surface. The unusually large diameter of the compression roll eliminates "shoving" of materials being compacted. Compacting effort varies from 310 lbs. with roll empty up to a maximum of 370 lbs (per lineal inch of roll width) with roll ballasted. The compression roll is equipped with front and rear tension scrapers and mats for moistening the roll when compacting finish materials. Some of the other features listed in the specifications are: powerful four cylinder gasoline engine completely enclosed under housing; constant-mesh transmission; twin disc clutch; foot brake; spur gear final drive; adjustable, swivel, operator's seat which gives unobstructed visibility for forward and reverse operation. **The Galion Iron Works & Mfg. Co., Galion, Ohio.**

Submersible Pump

A SUBMERSIBLE PUMP with many new features has been announced. It is a self-priming deep well pump installed below the water level, and is easy to install simply by added pipe lengths to the depth of the water. No jets, rods or shafts are required. It is water-cooled, water-lubricated and self-priming. It is designed to deliver unusually high capacities at settings in excess of 70 ft with well diameters of 4 in. and larger. The entire effort of the pump is concentrated toward raising

(*Continued on page 100*)

Another *tough* foundation problem solved with DRILLED-IN TRADE MARK CAISSONS

Cylinders installed through 60 feet of highly plastic clay and socketed into anorthosite rock.
Locked in the Rock
Puyjalon River crossing abutment supporting plate girder railroad bridge. Cylinders were battered 1:6 both longitudinally and transversally with bridge.
Executed for FRASER-BRACE Engineering Co., Inc.

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• SPENCER, WHITE & PRENTIS, NEW YORK
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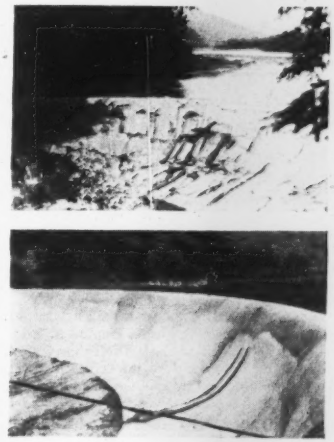

These two photos show a large, circular, gravity dam belonging to a large Eastern power company, and is just one of many that we have repaired with "GUNITE" for this organization.

The Upper View shows the advanced state of disintegration existing before our Contract Department started work on the dam; lower view shows the completed job.

After chipping out the loose and disintegrated concrete and sandblasting the entire area, heavy reinforcing mesh was placed over the surface and two inches of "GUNITE" applied.

This, and scores of similar "GUNITE" jobs we have performed are illustrated and described in Bulletin B2400. Write today, on your letterhead, for a free copy.

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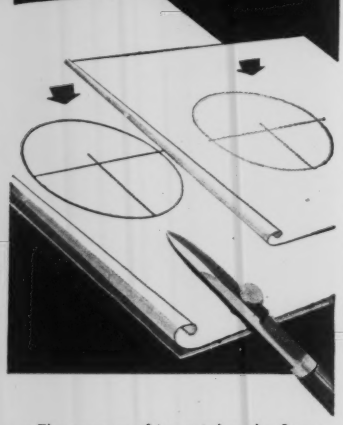

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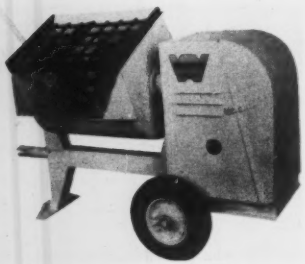
Equipment, Materials & Methods (Continued)

water through the service line. No suction line is required, and no horsepower is spent in turning long shafts, raising lengths of rod or cycling water through jets. Priming is never required in the submersible pump, as all operating elements are under water. The motor and pump are assembled in a tubular frame and the entire unit is installed in the well below pumping level. The motor embodies a sealed rotor and stator, and is water-lubricated and water-cooled. The motor relay and capacitor are located in a control box above ground where they are easily accessible, and may be removed without disturbing the main well installation. Accurately balanced impellers operate on a stainless steel shaft held by high grade bearing sleeves and rotating in time-tested, sand-resistant rubber bearings. Undesirable motor noise and vibration are eliminated due to the fact that the entire pumping unit operates under water. **Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago 5, Ill.**

Hoe Type Mixer

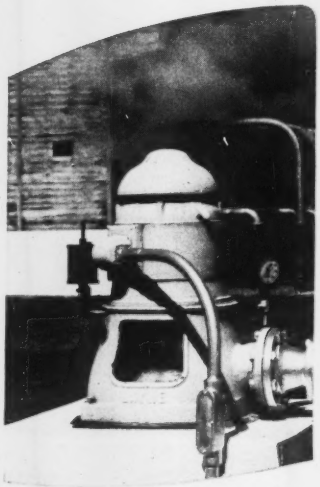
THE HOE-BOY 3 cu ft capacity hoe type mixer, has been primarily designed for inside work right at the point of application. Available with either gas or electric power, the Hoe-Boy features the exclusive triple hoe action found in larger CMC machines. Other features of the



Available with Gas or Electric Power

mixer are adjustable, triple-blade mixing hoes, safety grating and bag splitter, self-aligning, self-lubricating shaft bearings, heavy duty electric welded frame, machine cut sprockets and roller chain drive. The Hoe-Boy is only 29 in. wide, with a 36½ in. charging height and 15 in. discharge. **Construction Machinery Company, Glenwood and Vinton, Waterloo, Iowa.**

When Requesting Product Information Please Mention Civil Engineering



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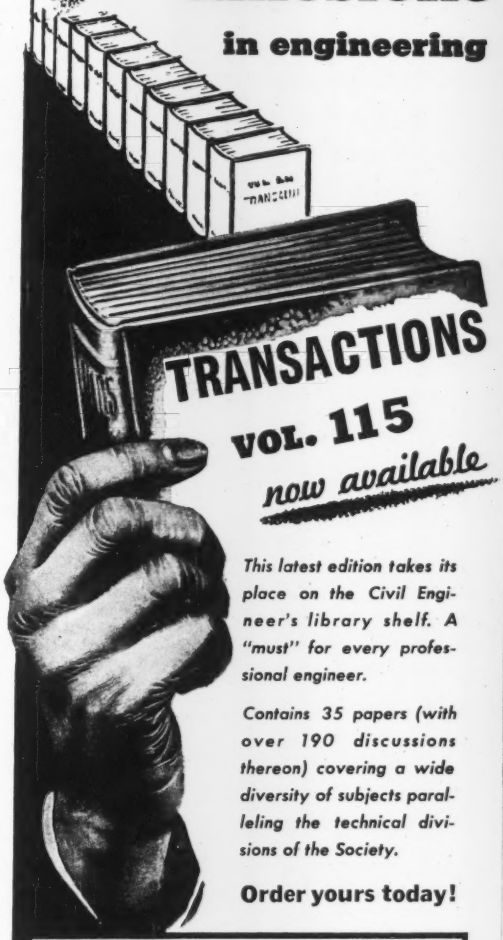

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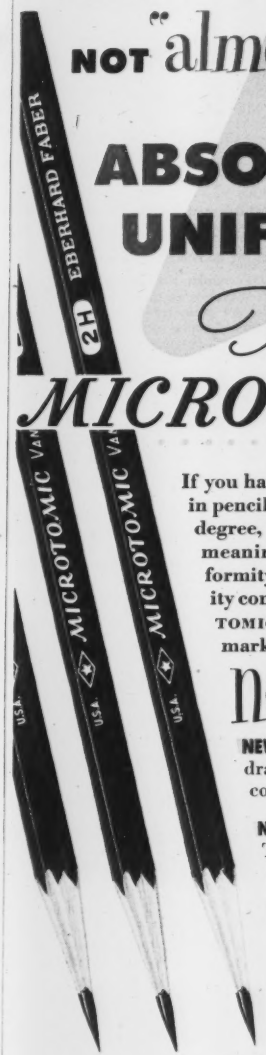

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Equipment, Materials & Methods (Continued)

Gasoline Engine

A 6-CYLINDER ENGINE, Hercules Model QXD-5, has been introduced, and used with the Gardner-Denver Model WH-105 two stage, portable air compressor. The engine has a $3\text{-}^{7}/_{16}$ in. bore and $4\text{-}^{1}/_{8}$ in. stroke. The piston displacement is 230 cu in. The crankcase and cylinder block of the QXD-5 engine are cast integral to insure perfect alignment of crankshaft bearings and cylinder bores. The high compression, high turbulence cylinder head assures maximum power and operating economy. The sturdy seven bearing

Powered by Hercules

crankshaft is accurately machined, heat treated and carefully balanced, both statically and dynamically. To facilitate the use of sturdier and more durable bearing metal, both main and connecting rod journals are "Tocco" hardened. Pistons are the light weight, aluminum alloy type, designed for heavy duty operation and rapid heat dissipation and reinforced to provide long life service. Each piston has four rings—one oil ring and three compression rings above the piston pin. Model QXD-5, engine is equipped with an oversized, gear driven oil pump which provides pressure lubrication to all main, connecting rod and idler gear bearings. An efficient cooling system is provided by full length water jackets around all cylinders and by the high capacity, positive gear driven water pump. The water pump is designed to eliminate misalignment and undue wear on vital parts. **Hercules Motors Corporation, Canton, Ohio.**

Aluminum Alloy Rivet

AN ALUMINUM ALLOY RIVET in the large size range, designated as "SB775", stronger than any heretofore available, has been developed. Rivets of this material can be hot driven by hand pneumatic hammers. It has the following characteristics: an average shear strength of 38,000 psi within two weeks after driving, a wide temperature range for driving, and good resistance to corrosion when used in recommended applications. The best results for the final driven rivet are predicted on the normal paint pro-

(Continued on page 103)

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No. 3. Precision Investment Casting by the Lost Wax Process. 111 references. 1949. $2.50.

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Equipment, Materials & Methods (Continued)

tection afforded various aluminum structural applications. The average rivet shear strength of 38,000 psi is considerably greater than anything that has ever been offered before in the large size range. The high strength of the rivet combined with its favorable driving characteristics now makes it possible to replace steel rivets in such aluminum applications as bridges and railroad cars. When duplicating those aluminum structures that in the past have been designed using other aluminum alloy rivets, it will be possible now to reduce the bulk and complexity of the joints by using the stronger XB77S rivets. This in turn should appreciably reduce erection costs. The rivets are available in the 1/2, 5/8, 3/4, 7/8 and 1 in. sizes. **Aluminum Company of America, 801 Gulf Bldg., Pittsburgh 19, Pa.**

Materials Handling Loader

A WHEEL TRACTOR LOADER called the TL-10 Tracto-Loader, features a hydraulic torque converter drive and a new design clutch-type transmission. The single stage torque converter furnishes a smooth, constant flow of power to the drive wheels. There is practically no spinning of wheels while loading, and crowding action is definitely improved. Loading in a higher gear

Model TL-10

is possible, operation is easier and there is less wear and tear on clutches and other parts. The clutch-type transmission eliminates most gear shifting. Two multiple disc clutches are built into the transmission. One is for forward speeds, the other for reverse. Only one clutch is engaged at a time. The operator can go forward or reverse by simply pushing or pulling one lever. His reverse speed is almost twice as fast as his forward speed. There is a selection of four forward and four reverse speed ranges. The TL-10 is mounted on rubber tires, has a 3/4-cu yd, hydraulically controlled bucket and weighs 10,650 lb. There is ample bucket clearance and reach to load average size dump trucks. Power is furnished by an Allis-Chalmers 40.5 brake hp. gasoline engine. **Tractomotive Corporation, Deerfield, Ill.**

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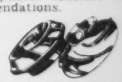

CHOICE OF IMPELLERS—Either bronze or cast iron Vitreous Enameled closed type impellers are furnished on Johnston Pumps. All controlling factors—well conditions, lift, capacity, pressure—are studied before one or the other is recommended. Semi-open type impellers are ideally suited to some conditions. They will not freeze or clog where the liquid contains gritty or pulpy matter. The clearance between impeller and bowl seat can be adjusted at the surface to suit the particular conditions under which the pump is operating.

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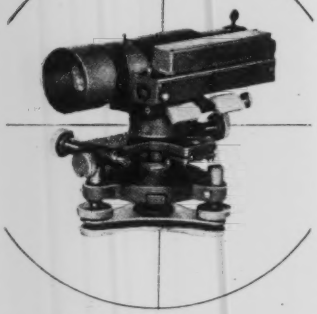

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Literature Available

PUMP—A revised bulletin on Rex Pumpcrete has just been released. The book describes the Pumperete machine itself and the method of pumping concrete through pipeline. It indicates on which type of jobs Pumperete will work to advantage, what types of mixes it will handle, and the height and distance requirements of a placing job. Request Bulletin No. 51-31 from **Chain Belt Company, 1600 W. Bruce St., Milwaukee 4, Wis.**

MAINTENANCE CHECKING CHART—The "Maintenance Checking Chart" will be of interest to every plant and building maintenance superintendent. This complete chart lists many common building maintenance problems and recommends a solution for each. It lists over 100 products and processes for maintenance of floors, roofs, interior and exterior walls, waterproofing, special paints, etc. **United Laboratories, Inc., 16801 Euclid Ave., Cleveland 12, Ohio.**

METAL PIPE—A 16-page booklet entitled "Armco Corrugated Metal Pipe—A Type for Every Need" has been published. It lists the types of full-round pipe and pipe-arch available to meet the specific requirements for various types of sewers, culverts, conduits or irrigation systems. The booklet also contains reference data for assistance in selecting the most suitable structure. Also included are details on fittings and instructions on the installation of Armco drainage structures. **Armco Drainage & Metal Products, Inc., General Offices, Middletown, Ohio.**

COMBINATION PAVER—A curb, gutter, and sidewalk paver, called "Speedmaster," is described in action in a 425-ft, 16-mm sound film recently released. The installation of curb and gutter on U. S. Highway 12, Jackson, Mich., the Chicago and Detroit superhighway, and other highway projects in Michigan, Colorado, and Washington, D.C., is shown in the motion picture. Prints are available for showing to schools, engineering societies, and other interested organizations. Requests should be addressed to **Mr. A. B. Subject, Pres., Dotmar Industries, Inc., 503 Hanselman Bldg., Kalamazoo, Mich.**

BALL BEARING CATALOG—The 20th edition of the New Departure ball bearing catalog, contains numerous added features of interest and value to ball bearing users. Selection of bearing type and size for various conditions of load and speed is considerably simplified and illustrated by examples. Load rating tables now give both radial and thrust capacities for all bearings except those types which are designed for certain specialized services, and speeds now have been arranged to include those for synchronous motors. Several more types of single row and double row angular contact bearings have been added. **New Departure Div., General Motors Corp., Bristol, Conn.**

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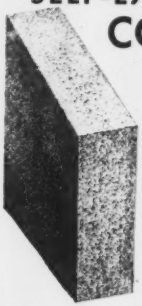

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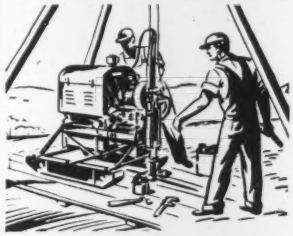

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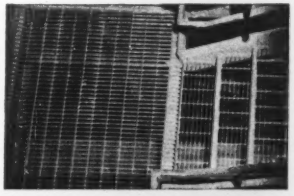

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Literature Available (Continued)

DRAINAGE PRODUCTS—An illustrated 46-page manual on the installation of drainage products, has been published. It is intended to assist construction engineers, superintendents, and foremen in the proper methods of installing drainage structures, culverts, sewers, or conduits. The manual discusses the handling of metal drainage products, location, proper excavation and preparation of base in various types of foundation soils and rock. Installation of underdrains to insure proper functioning is also discussed. Detailed sketches are used throughout the manual to illustrate important installation recommendations. **Armco Drainage & Metal Products, Inc., Middletown, Ohio**

MANGANESE STEEL—"Hard Surfacing Manganese Steel" is the title of a 4-page bulletin just released. The article outlines applications, precautions and suggestions on the proper procedures. Basically it states that the success in the facing of manganese is in avoiding reaching high temperatures throughout the body of the steel, a precaution which should be observed on pieces even as small as a shovel tooth. It is stated that where precautions as outlined in this article have been observed, manganese has been successfully hard surfaced, saving users of manganese steel many thousands of dollars. **Rankin Mfg. Co., 3072 West Pico Blvd., Los Angeles 6, Calif.**

PRECAST PRESTRESSED CONCRETE SLABS—A catalog on Flexicore prestressed concrete floor and roof slabs is offered. Special features include: diagrams showing how Flexicore slabs are used with all types of construction; a simplified load chart; an explanation of how prestressing Flexicore slabs permits heavier loads on longer clear spans; and new ways to install heating systems, including hot water radiant and a warm air split system that combines circulating air with a radiant floor. **The Flexicore Co., Inc., P. O. Box 825, 1932 East Monument Ave., Dayton 1, Ohio.**

LUMBER—The publication of the 1951 "Where to Buy" booklet contains 40 pages and is 8½ by 11 in. in size. This directory of membefs of the Association is designed to aid buyers of Douglas fir, West Coast hemlock, Sitka spruce and Western red cedar. Detailed information is given on sawmills, remanufacturing plants, timber fabricators, a wood pipe and tank manufacturer and wood treating plants in the Douglas fir region of Western Washington, Oregon and Northern California. New member mills total 66 since the 1950 edition and their listing along with the changes in the previous members will give lumber buyers the latest information on mill locations, officials and sales offices, capacities, facilities and products manufactured. **West Coast Lumbermen's Assoc., 1410 S. W. Morrison St., Portland 5, Ore.**

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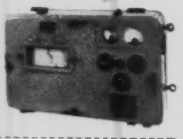

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Literature Available (Continued)

WALL FORM CONSTRUCTION—An enlarged, completely illustrated catalog describing Uniforms and the Uni-Form system of wall form construction has recently been published. Uni-Forms are widely used in every type of concrete forming work. **Universal Form Clamp Co., 1428 N. Kostner Ave., Chicago, Ill.**

VALVES—A 6-page bulletin, 5-2, fully describing the cushioned single-acting nonreturn valve is now available. Three different yoke assemblies on the elbow, angle and globe bodies are featured in detailed drawings, with a complete list of parts. The adaptability, testing, construction, installation, sequence of operation, servicing and specifications are fully described, along with tables showing general dimensions, approximate shipping weight, and general list of materials. **Golden-Anderson Valve Specialty Co., 2102 Keenan Bldg., Pittsburgh 22, Pa.**

HYDRAULIC PULLERS AND JACKS—An 8-page bulletin, Hydraulic 51, discusses labor-saving applications of hydraulic pullers and jacks. The bulletin also introduces "Simplex Re-Mo-Trol hydraulic pumps and remote-controlled rams. It illustrates how these units simplify rigging requirements and improve safety in numerous pulling, pushing and lifting operations, by means of center-hole tubular ram construction. Complete specifications of Re-Mo-Trol units and all other Simplex hydraulic jacks and jennies are included. **Templeton, Kenly and Co., 1020 So. Central Ave., Chicago 44, Ill.**

CHLORINIZER—Bulletin (840-G27) on the Model HCVS volumetric chlorinizer has been issued. The 4-page bulletin describes the high capacity visible flow chlorinizer which is designed to meter chlorine gas accurately at rates up to 6000 lbs per 24 hrs. It lists many features and shows a cut-away drawing of the functioning parts. An easily readable diagram shows how the operation of the chlorinizer is carried out. There is also a discussion of operation of the rate of flow indicator, low maintenance costs, and installation. **Builders-Providence, Inc., 345 Harris Ave., Providence 9, R. I.**

SYNCHRONOUS GENERATOR—A 32-page bulletin entitled "Hydraulic Turbine Driven Synchronous Generators and Large Vertical Motors" has been released. The bulletin compares the suspended and umbrella types of vertical generators, describing construction standards and details of stator, rotor, bearing and bearing housing construction. It shows the advantages of enclosed construction using air-to-water heat exchangers. In addition to the vertical generators, the horizontal generator is described. Special modifications that can be incorporated into the design of hydraulic turbine generators are listed, along with accessories and tools. Ask for Bulletin 05B7549, from **Allis-Chalmers Manufacturing Company, 1187 S. 70th St., Milwaukee, Wis.**

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TIDE GATES

Fig. B-124-D
Two 60" Type M Gates on Relief Culverts near Woodward Pumping Station, Plymouth, Pa.

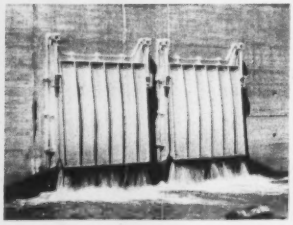

Fig. B-124-C
Two 72" x 72" Type M-M Gates on Toby Creek Outlet Works, Plymouth, Pa.

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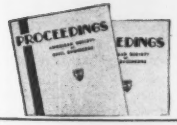

PROCEEDINGS AVAILABLE

The following papers, printed as Proceedings Separates, may be ordered on the basis of summaries given in this and previous issues of CIVIL ENGINEERING. Discussions of these papers will be received as in the past, for a period of five months following the date of issue. A summary of each paper appears in several consecutive issues; other titles will be added every month, as they become available. Use the convenient order form on page 108.

Summarized in Earlier Issues

46. Human Aspects of Mexican Irrigation, by Antonio Rodríquez L.

47. Operation and Maintenance of Irrigation Systems, by Raymond A. Hill.

48. Compaction of Cohesive Soils: Progress Report of the Subcommittee on Consolidation of Materials in Earth Dams and Their Foundations of the Committee on Earth Dams of the Soil Mechanics and Foundations Division.

D-XXVII. Discussion of Symposium, **Design Characteristics of Lock Systems in the United States.**

D-2. Discussion of Paper, **Public Utility Condemnation Cases in the State of Washington,** by Henry L. Gray.

D-3. Discussion of Paper, **Treatment of Foundations for Large Dams by Grouting Methods,** by A. W. Simonds, Fred H. Lippold, and R. E. Keim.

D-9. Discussion of Paper, **Atchafalaya Diversion and Its Effect on the Mississippi River,** by Leo M. Odom.

49. Large Hyperbolic Functions Computed by Fission, by F. T. Llewellyn.

50. Supersonic Sounding Instruments and Methods, by Joseph M. Caldwell.

51. Laterally Loaded Plane Structures and Structures Curved in Space, by Frank Baron and James P. Michalos.

52. Some Aspects of Electronic Surveying, by Carl I. Aslakson.

53. Wedge-Beam Framing, by Arsham Amirikian.

54. Truss Deflections by the Coordinate Method, by Kuang-Han Chu.

55. Measurement of Sedimentation in Small Reservoirs, by L. C. Gottschalk.

56. Turbulent Transfer Mechanism and Suspended Sediment in Closed Channels, by Hassan M. Ismail.

57. Design of Irrigation Systems, by W. H. Nalder.

58. Highway Planning in Turkey, by H. E. Hilts.

59. Limit Design of Beams and Frames, by H. J. Greenberg and W. Prager.

60. Surveying and Mapping Requirements for Modern City Planning, by Charles A. Blessing.

D-7. Discussion of Paper, **The Geochemistry of Earthwork,** by Hyde Forbes.

D-XXV. Discussion of Paper, **Numerical Computation of Buckling Loads by Finite Differences,** by Mario G. Salvadori.

Third Notice

61. Structural Damping in Suspension Bridges, by the late Friedrich Bleich and L. W. Teller. In three parts, this paper comprises (1) a theoretical study of damping capacity of suspension bridges resulting from internal friction and from various sources of dry or Coulomb friction in the structure, (2) an account of an extensive laboratory study of frictional damping in structural members, and (3) a correlation of the theory with experimental data. (Available April 1.)

62. The New Towns Program in Great Britain, by T. C. Coote. Fourteen new towns are now under construction in Great Britain. Two are in Scotland, eleven in England, and one in Wales. These new towns are being erected by development corporations which employ their own technical staffs or outside consultants. Construction work is gathering momentum, and in each of the earlier established new towns it is planned to erect about 1,000 houses, together with some factories and shops. Extensive civil engineering works are being undertaken to open up the sites. (Available April 1.)

63. National Geodesy—Status and Planning, by Leo Otis Colbert. From its inception, the United States Coast and Geodetic Survey has been engaged in establishing the horizontal and vertical controls necessary as a base for land surveys and engineering projects. The paper describes the development of the geodetic network, the status of control surveys, and the scheduling of future geodetic work. The role of the engineer in preserving existing reference points is emphasized. (Available April 1.)

D-8. Discussion of Paper, **Floating Tunnel for Long Water Crossings,** by Charles E. Andrew. The original paper, published in March 1950, outlined a study of possible methods, if any, of constructing a permanent highway structure across Puget Sound between Seattle, Wash., on the east and the mainland on the west shore. Discussers are: Robert S. Mayo, Homer M. Hadley, and Charles E. Andrew. (Available April 1.)

D-11. Discussion of Paper, **Long-Term Storage Capacity of Reservoirs,** by H. E. Hurst. The original paper, published in April 1950, presented a solution of the problem of determining the reservoir storage required on a given stream to guarantee a given draft. Discussers are: Ven Te Chow, Henri Milleret, Louis M. Laushey, and H. E. Hurst. (Available April 1.)

D-16. Discussion of Paper, **Pavement Bearing Capacity Computed by Theory of Layered Systems,** by Guthlac Wilson and G. M. J. Williams. The original paper, published in May 1950, described a method for calculating the bearing capacity of rigid and flexible pavements, which was based on the theory of layered elastic systems. Discussers are: Robert Ruckli, Hugh Q. Golder, and Guthlac Wilson and G. M. J. Williams. (Available April 1.)

D-19. Discussion of Paper, **Flood-Control Operation of Tennessee Valley Authority Reservoirs,** by Edward J. Rutter. The original paper, published in May 1950, discussed the actual flood conditions and actual and alternative hypothetical operations of the tributary and main-river reservoirs during these floods. Discussers are: Ray K. Linsley, Jr., and Edward J. Rutter. (Available April 1.)

D-23. Discussion of Paper, **Influence of Heavy Loads on Pavement Design Trends,** by K. B. Woods. The original paper, published in June 1950, developed the design of highway pavements through extensive use of test roads, the use of theoretical or rational procedures, and through the combined experiences of many

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highway engineers over a considerable period of time. Discussers are: William S. Pollard, Jr. and K. B. Woods. (Available April 1.)

Second Notice

64. Planning the National Capital: Objectives and Problems of Attainment, by Ulysses S. Grant III. The important contribution made by engineers to the planning and development of Washington, D.C., is detailed. Discussed briefly are the current major problems of the city and the measures taken for their solution. The need for legislation to enhance the effectiveness of the Planning Commission is explained, and a federal and interstate Metropolitan Works Agency to provide for the financing and design of construction work needed by the metropolitan area as a whole is advocated but not as the direct responsibility of any one of the political jurisdictions. (Available May 1.)

65. National Topographic Mapping, by W. E. Wrather. The present status of topographic mapping of the United States and the rapid rate of obsolescence of the older topographic maps are discussed, together with standards and specifications that are expected to decrease the rate of obsolescence of modern quadrangle maps. The paper explains the manner and extent of cooperation in effect between the Geological Survey and other federal and state agencies for the purpose of expediting progress on the national topographic mapping program and the practicability of a 20-year schedule for completing standard topographic quadrangles of the United States. (Available May 1.)

66. Lateral Forces of Earthquake and Wind, by a Joint Committee of the San Francisco, Calif., Section, ASCE, and the Structural Engineers Association of Northern California. This paper develops a dynamic criterion for design lateral earthquake and wind forces and a provision for building codes based on this criterion. The earthquake shear transmitted from the ground to a structure is related to the weight and natural period of vibration of the structure. This shear is resolved into lateral forces at various levels. The lateral force code, drawn for California conditions, is generally applicable with some modification. (Available May 1.)

D-13. Discussion of Paper, **Reinforced Concrete Skewed Rigid-Frame and Arch Bridges,** by Maurice Barron. The original paper, published in April 1950, presented a method of analysis and design that indicates the effect of skew on a barrel arch or rigid-frame structure. Discussers are: D. A. Nettleton, Ernest H. Harder, Egidio O. Di Genova, Kuang-Han Chu, Harold E. Levenson, Walter L. Schwartz, Leo Sos, Leif Arup, and Maurice Barron. (Available May 1.)

D-18. Discussion of Paper, **Successive Approximations for Beams on an Elastic Foundation,** by E. P. Popov. The original paper, published in May 1950, gave a general method for solving problems of variable moment of inertia of a beam and variable foundation modulus. Discussers are: Ralph E. Fadum, J. V. du Plessis, W. E. Hanson, Jacob Karol, E. E. De Beer and D. Krsmanovitch, and E. P. Popov. (Available May 1.)

D-21. Discussion of Paper, **Maximum Load Capacity of Bailey Bridges,** by Robert B. Stegmaier, Jr. The original paper, published in June 1950, reviewed the use of load tests in determining the maximum capacity of military bridges. Discussers are: D. Allan Firmage, and Robert B. Stegmaier, Jr. (Available May 1.)

First Notice

67. Model and Prototype Studies of Sand Traps, by Ralph L. Parshall. Two successful methods of controlling the deposition of waterborne gravel and sand in power and irrigation canals are discussed and illustrated. The vortex tube and riffle deflector have proved effective in trapping the bed load in actual installations as well as in laboratory tests. The design and operation of these devices is outlined and their relative efficiencies are compared. (Available June 1.)

68. International Cartography, by Robert H. Randall. Modern transportation and communication facilities have made it imperative to secure cartographic cooperation on a much wider basis than in the past. Attempts to secure such cooperation among the nations of the world are described. The purposes, methods of operation, and accomplishments of several international cartographic organizations are given as well as details of United Nations participation in the planning. (Available June 1.)

69. Valuation and Depreciation Related to Income Tax, by Maurice R. Scharff. This paper supplements a previous paper by suggesting a procedure by which income tax can be taken into account in economic comparisons of engineering projects and in valuations of public utility property, based upon present worth of earning power. In effect income tax is treated as an additional fixed charge on investment. Algebraic formulas are presented and illustrated by examples. (Available June 1.)

70. Regime Theory for Self-Formed Sediment-Bearing Channels, by T. Blench. Major river diversions for irrigation have proceeded in India since 1890 under conditions of (1) sediment-laden water, (2) excavated canal boundaries of erodible alluvium, and (3) very flat country. Rational formulas have been developed for the final self-adjusted dimensions of such canals. The formulas fit and amplify the framework of rigid-boundary hydraulics. Applications are made to the consequences of interfering with river regime. (Available June 1.)

71. Rectification of the Papaloapan River in Mexico, by Reynaldo Schega. The Papaloapan River in Mexico is undergoing rectification by means of six cutoffs, as a first step in a comprehensive development of its basin for flood control, navigation, and power production, undertaken by the government of Mexico. The system of cutting off river bends by excavating pilot cuts that the river subsequently enlarges into full-sized channels is patterned after that adopted on the Mississippi River. The status of the project two years after the pilot cuts were dug is presented, illustrated by aerial photographs. (Available June 1.)

D-24. Discussion of Paper, **Buckling of Rigid-Jointed Plane Trusses,** by N. J. Hoff, Bruno A. Boley, S. V. Nardo, and Sara Kaufman. The original paper, published in June 1950, gave rigorous methods of calculating the elastic restraint of adjacent members on a compression member and also of determining the effect of gusset plates on rigidity. Discussers are: Jacob Karol; Alfred S. Niles; Thomas C. Kavanagh; George Winter and Oliver G. Julian; N. J. Hoff, Bruno A. Boley, S. V. Nardo, and Sara Kaufman. (Available June 1.)

D-27. Discussion of Paper, **Plasticity of Metals—Mathematical Theory and Structural Applications,** by D. C. Drucker. The original paper, published in August 1950, emphasized the importance of plasticity in elastic design and illustrated the use of elementary plastic analysis. Discussers are R. W. Steed, Jacob Karol, S. K. Ghaswala, and D. C. Drucker. (Available June 1.)

D-28. Discussion of Paper, **Retrogression on the Lower Colorado River After 1935,** by J. W. Stanley. The original paper, published in August 1950, discussed the control of floods and sediment deposition in the lower Colorado River made necessary by the construction of Hoover Dam. Discussers are: T. Blench, E. W. Lane, and J. W. Stanley. (Available June 1.)

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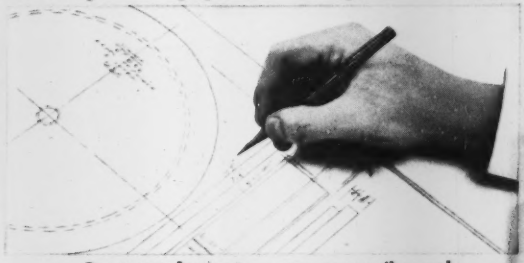

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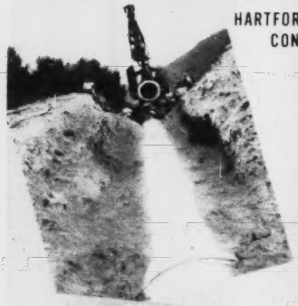

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